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The Effect of the War on the Stocks of Commercial Food Fishes.

Preface.

At the meeting of the International Council for the Exploration of the Sea in 1946, the following Recommendation was made by the Consultative Committee and passed by the Council:

"That a Special Scientific Meeting be held at the next meeting of the Council to discuss 'The Effect of the War on the Stocks of Commercial Food Fishes', and that Dr. R. S. CLARK should act as Convener for the purpose."

The meeting recommended took place in Copenhagen on the 24th October 1947. The main object of the meeting was to define the state of the stocks of fish immediately on the conclusion of hostilities, and so to prevent a recurrence of what happened after the first world war. The Convener, Dr. R. S. CLARK, had desired that the meeting itself should be wholly devoted to discussions. Typescripts of the various papers were therefore circulated to delegates and experts attending the Council meeting. Manuscripts were received from:

Denmark: Å. J. C. JENSEN, on Plaice;
England: A. R. MARGETTS and S. J. HOLT, on 1) North Sea Trawl Fisheries and 2) The English Plaice Fishery;
France: R. LETACONNOUX, on Various Fishes;
Norway: G. ROLLEFSEN, on The Arcto-Norwegian Stock of Cod;
Poland: Z. MULICKI, on Flounder;
Scotland: B. B. PARRISH, on Haddock;
Sweden: A. R. MOLANDER, on Witch and Ling.

General Secretary.

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Scientific Meeting

on the Effect of the War on the Stocks of Commercial Food Fishes.

Friday, 24th October, 1947.

Proceedings.

Chairman: Dr. R. S. Clark
Reporter: Mr. Michael Graham.

The Chairman opened the first session at 9.45 a. m. He explained that the purpose of the meeting was to establish the facts about the effect of the war, and that it would be best on this occasion not to expand the subject beyond the terms of reference.

Papers had been circulated in advance of the meeting, and he ruled that these papers should not now be read, but that each author should explain to the meeting what were the main points brought out in his paper.

During the morning session, authors, or their representatives, spoke on the subject of their papers, every author or representative being given a second opportunity in the later part of the morning, in case he had forgotten to mention anything in his first remarks, or had been prevented by lack of time.

The second session was opened at 2.40 p. m. The Chairman called on the Reporter to give a critical resumé of all the papers presented, and of such other relevant papers as had been published already. The Reporter then gave his review of the papers. This review was interrupted from time to time, so that the Chairman could ask the authors concerned if the Reporter's remarks did justice to the main points in their papers, and a note was made of any additions proposed by the authors.

After finishing his review, the Reporter summed up as follows. Altogether, 12—14 fisheries had been investigated. There were many interesting and important differences in detail, but, for most of them, the main effects of the war were closely similar. Only in one fishery, that of the Swedish fishery for witch, was the evidence not very clear, owing to the dominance of the yield by the voluntary regulations of the Swedish fishermen's organisations. In all the others, the principal facts were perfectly clear. In one stock — that of the Arcto-Norwegian cod — it had been made quite clear that the reduction of fishing during the war period did not cause the observed changes in the yield. In all other fisheries investigated, 10 or more, separated as far apart as Gdynia and La Rochelle, the principal effects were the same, namely:

1) an increase of density of stock, frequently of the order of 3-fold, ascribable to greater survival to older ages.

2) Some changes in growth-rate, but insufficient to prevent the augmentation of the stock.

The Chairman invited the meeting to discuss these points, but nobody responded. So after a short adjournment, the Chairman put it to the meeting that these effects had been so clearly established that no discussion was required, but he again invited discussion. The Chairman then said that he took it that the meeting agreed with these main points, and that no further discussion was necessary; so he would proceed to some of the interesting and important subjects on which he invited speculative discussion, seeing that they were mainly beyond our present knowledge. These subjects were:—

a) The Balance of Nature, and the extent to which the ecological situation could be restored by conservation measures,

b) The maximum stock and limiting factors,

c) The rate of recruitment.

An interesting discussion followed, in which many members took part.

The meeting terminated at 4.45 p. m.

Reporter's Review.

The changes in yield of the **Arcto-Norwegian stock of cod** were not due to war-time reduction of fishing, this conclusion follows from:

a) the history of the fishery which showed, for example, great yields during a period of great fishing — by the steam trawlers.

b) the productiveness of the 1937 year-class and the unproductiveness of other recent year-classes, despite reduction of fishing during the period of the war. It is not conceivable that a war effect would be confined to the 1937 year-class alone.

In the Swedish **witch** fishery changes in the yield were complex, but were in the main best ascribed to alterations in the voluntary regulatory measures of the fishermen. A particular fishery, off Hanstholm, when an area was closed by a mine-field, showed marked increase of large witches on its reopening.

The Swedish **ling** fishery in the North Sea shows that the density of stock is increased approximately 4-fold.

The **flounder** fishery near Gdynia showed a 3-fold increase in density, due to an increased percentage of larger fish, which were shown to be older. In flatfish catches the percentage of plaice had increased, of dab decreased.

Plaice.

In the Danish fishery in the *Transition Area* a fleet giving somewhat reduced intensity of fishing was prohibited from fishing in many mine-fields. This state continued until 1944, but the yield improved steadily, and finally became very great in 1945—46. The stock evidently recovered in the closed areas and spread to other areas.

In the *North Sea* the Danish fishery showed a 3-fold increase of density, and there was an improvement in cod and haddock stocks. The international yield of the fishery during the war years was not much less than before the war, but nevertheless the stocks increased, because of the respite from trawling. The author emphasized that vigorous fishing by Danish seine had not prevented this increase. There were changes in growth-rate.

The fishery for plaice etc. by Netherlands fishermen showed the effects reported on by G. P. Baerends in Annales Biologiques Vol. II, p. 60. There was a 3-fold increase in density of all species taken together, and the percentage of "small" was much less. This applied to plaice, cod, haddock, and sole. Dabs increased but little.

The plaice of the *southern North Sea* in the English fishery showed an increase in density 3-fold by weight, 2-fold by number, and an increase in the proportion of older fish. The rate of recruitment was not increased. See also Ann. Biolog. Vol. II, p. 68, where Wimpenny showed that the increased density was already noticeable by 1942.

The **haddock** fished by Scotland in the *North Sea* showed a 4—5 fold increase in density, and a marked increase in the proportion of larger and older fish. (See also Ann. Biolog. Vol. II, p. 35).

In discussion, notes on the Swedish **haddock** fishery were given, referring to the northern North Sea. The yield had increased markedly compared with pre-war years and the percentage of large haddock rose from 5.3 to 98.7 in 1945, receding to about 93 in 1946.

Other species in the North Sea, cod, sole, turbot, showed increases from 4 to 5-fold, but the whiting only increased slightly. The proportions of species changed slightly, sole becoming more important, whiting less.

In the **hake** fishery from La Rochelle there has been an increase in weight-density of over 2-fold, with the percentage of large changing from 66 to 82. Other species showed increases and there were interesting minor changes in the proportions of species.

The English hake fishery has been described year by year during the war by Hickling (English Fishery Investigations, II, Vol. XVII, 1, 1946). After 1942 a fleet between one third and one half that of the inter-war years, yielded between twice and three times the weight of hake.

To sum up, the Swedish witch fishery gives no clear evidence, and the Arcto-Norwegian cod stock is, at present, independent of fishing operations, but in all other papers, describing about a dozen stocks or part stocks, the principal facts are similar:

a) An increase of density due to greater survival.

b) Changes in growth-rate but not of sufficient magnitude to prevent the increase in density.

Many interesting second-order effects are to be found in the original papers.

1.

THE ARCTO-NORWEGIAN STOCK OF COD

By

GUNNAR ROLLEFSEN

Experience of the effects of two periods of reduced fishing in the North Sea makes it of interest to investigate whether similar effects apply to stocks of fish in other regions.

During the first World War the toll taken of cod in the northern and Arctic waters, was not reduced so much as during the recent war. During the inter-war period a number of nations had developed fairly large fleets of trawlers which fished in these remote waters. It was especially during the ten years immediately prior to the late war that large-scale trawling was carried out in addition to the fishing with other gear. All fishing in the Barents Sea ceased on the outbreak of war. A period of protection began.

Experience has shown that the catch curve of the Norwegian Lofoten fishery may serve as a guide to the evaluation of the fluctuations of the Arcto-Norwegian stock of cod. A glance at the course of this curve (see next page) would appear to show traces of the effects of protection.

During the war years there is a fall in the curve which might be taken as the after-effects of an earlier severe taxation of the younger fish. On the other hand we find in 1946—47 a rise which might be taken as the effects of protection during the preceding years. A closer analysis, however, reveals a number of facts which fail to support this view.

It is well known that the Norwegian cod fishery has always displayed very strong fluctuations, and the investigations of recent years suggest that at least three different causes of these fluctuations may be distinguished. We find that annual fluctuations may be related to meteorological and hydrographical conditions during the actual fishing season, and fluctuations of 3—5 years' duration can be traced back to the size of definite year-classes, while fluctuations of about 20 years' duration are probably due to the fact that the stock shrinks or expands over an extended period.

Before attempting to assess any effect of the reduced fishing in the war years it is necessary to point out that the Arcto-Norwegian stock of cod has been passing through a very rich period during the past 25 years, and that the stock as a whole, despite an increased fishery, seemed to be on the increase before the war. For simultaneously with the increasing fishing intensity and an increasing catch, the fish showed, on the whole, an increased individual size.

We must also realise, however, that the stock in former periods with a much smaller fishing intensity repeatedly seems to have declined heavily in the course of a few years, and remain small for a prolonged period, only to rise again suddenly. It is obvious that it is no easy task under such conditions to demonstrate the connection between the intensity of the fishery and the size of the stock, as has been done in the case of the North Sea stocks of fish.

The Arcto-Norwegian stock of cod in some respects, however, represents an ideal field for investigation, as the long spawning migration, which separates the sexually mature stock each year from the immature, makes possible the study of the mature and immature components in a pure state. This has facilitated the understanding of many problems which would otherwise have proved difficult.

It appears that while immature the Arcto-Norwegian stock of cod does not extend beyond the Barents Sea region. The most important fishing in our time in these waters is by trawlers. Practically all occurring age-groups, therefore, are now subjected to increased fishing, in contrast to former times when the fishing was by hook or line only.

We must assume, however, that the trawlers in their own interest, principally work the older age-groups of IV and upwards.

The sexually mature stock, which mixes with the immature during the feeding season is clearly also subjected to fishing in the Barents Sea from May

to October. However, the main fishing of the mature stock takes place during its spawning migration to the Norwegian coast from November to April.

When war broke out the two good year-classes of 1929 and 1930 were the chief components of the spawning shoals[1]), and they set their mark on the Lofoten fishing of 1939 and 1940 and considerably increased the catch. It must be taken into consideration that these two classes, both as immature cod "lodde torsk" in the Barents Sea, and as sexually mature cod, "skrei", on the Norwegian coast, had borne the brunt of the intensified fishing in the years 1935 to 1940. Nevertheless, they were able, despite the heavier taxation, to form a marked peak in the catch curve of the Lofoten fishery. This, too, suggests that the cod stock had considerable powers of resistance during these years.

When the two classes ebbed out, the Lofoten catch curve dropped correspondingly, remaining throughout the war years at an average level. From 1946 onwards, however, there was a sharp increase, with a record catch in 1947; this increase was due to a *single*, very strong year-class, that of 1937. It is out of the question that this class which is several times larger than the classes from the adjacent years, should alone have benefited from the protection in the Barents Sea. Its existence, and with it the increase in the Lofoten fishery, must have other causes than a reduced fishing intensity.

In my view, from this material we cannot demonstrate any effect on the stock from increased fishing before the war; also it cannot be demonstrated that the reduced fishing during the war had any effect[2]). But this is not, in my opinion, by any means a comforting statement. It is my view that the prolific period which the Arcto-Norwegian stock of cod has enjoyed during the past 25 years can be succeeded at any time by a less prolific period, perhaps of the same duration. We know that in the immediate pre-war years about 800,000 tons of this cod was fished. We know that requirements will greatly increase in the course of a few years, perhaps to 1,200,000 tons, perhaps more. It is an open question how a reduced stock will behave in the face of such requirements.

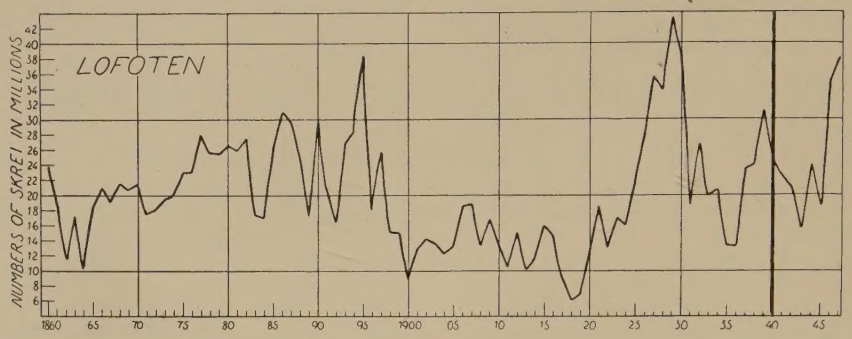

Figure 1. Catch Curve of the Norwegian Lofoten Fishery.

[1]) Information about the age distribution of the sexually mature stock in the pre-war and war years is given in *Annales Biologiques*, Vols. I and II.

[2]) Later investigations indicate a slight decrease in the mortality-rate during the war years.

2.

THE SWEDISH WITCH FISHERY IN THE SKAGERAK AND THE NORTH SEA

By

ARVID R. MOLANDER

The following report on the Swedish witch fishery is based on statistical material on the landing of witch received from the Göteborg fishery harbour. The great bulk of witch landings by Swedish fishermen are at Göteborg and for this reason the landing figures from there give a fairly reliable picture of the fishing in question.

Fishing in the Skagerak.

Landings of witch at Göteborg had sunk considerably already by the end of the 1920s (Fig. 1). This was probably due to a large extent to the *introduction of a minimum size* for witch, with the result that large quantities of small witch disappeared from the market. It was not until the last years of the 1920s that any large quantities of witch were landed at Göteborg from the North Sea; the bulk was still fished in the Skagerak where prior to the introduction of a minimum size the catches usually amounted to over 1,000 tons a year. In the 1930s (Table 1) witch fishing in the Skagerak showed substantially lower catch figures. Even though certain annual variations in the catches can be established during these years, some stability in the yield seems to have occurred, a fact which also applies to the composition of the catches (Figs. 2 and 3). This is probably due in no small degree to the limitation of the catch caused partly by the introduction of a minimum size and partly to the regulatory measures introduced by the fishermen's organizations themselves.

With the outbreak of war other factors made themselves felt. The witch fishery in the Skagerak became very varied and irregular. In 1941 the yield showed a big increase. This coincided with the discontinuance of the regulatory measures of the fishermen's organizations. The effect was primarily felt in a substantial increase in the numbers of small witch. The considerably lower catch figures in 1942 were probably due to the drastic restrictions on Swedish fishing enforced by certain German war measures. In 1943 a very considerable increase in the witch fishing in the Skagerak took place. It amounted to quantities not known since the middle 1920s. The minimum size regulations had then been abolished and large quantities of small witch were landed. Amendments to the sorting provisions caused especially a very big increase in the numbers of medium-sized witch. Continued very high catch figures were shown in 1944, but the decline in the fishing from 1943 was substantial. The heavy fishing in 1943 thus resulted in a clear weakening of the stock of witch in the Skagerak. This is still more apparent in 1945, when the witch catch dropped to the pre-war level.

From what has been said it is clear that the

Table 1. Landings of Witch of various Size-Groups from the Skagerak.

Year	Total catch tons	Large tons	Large %	Medium tons	Medium %	Small tons	Small %
1932.	571·2	135·7	23·8	216·2	37·8	219·2	38·4
1933.	365·1	104·0	28·5	128·0	35·1	133·0	36·4
1934.	339·3	100·8	29·7	122·9	36·2	115·6	34·1
1935.	342·0	97·5	28·5	122·3	35·8	122·2	35·7
1936.	300·5	79·4	26·4	111·4	37·1	109·7	36·5
1937.	262·5	67·1	25·6	94·4	36·0	101·0	38·4
1938.	453·8	117·6	25·9	162·5	35·8	173·7	38·3
1939.	407·9	105·6	25·9	137·4	33·7	164·8	40·4
1940.	373·4	85·6	22·9	127·2	34·1	160·7	43·0
1941.	683·9	127·9	18·7	196·0	28·7	360·0	52·6
1942.	364·8	64·3	17·6	107·9	29·6	192·5	52·8
1943.	1211·0	181·8	15·0	815·5	67·3	213·8	17·7
1944.	893·7	132·5	14·8	285·0	31·9	476·2	53·3
1945.	441·6	76·9	17·4	135·4	30·7	229·3	51·9
1946.	984·0	193·1	19·6	320·3	32·6	470·6	47·8
Total	7994·6	1669·8	20·9	3082·5	38·6	3242·3	40·5

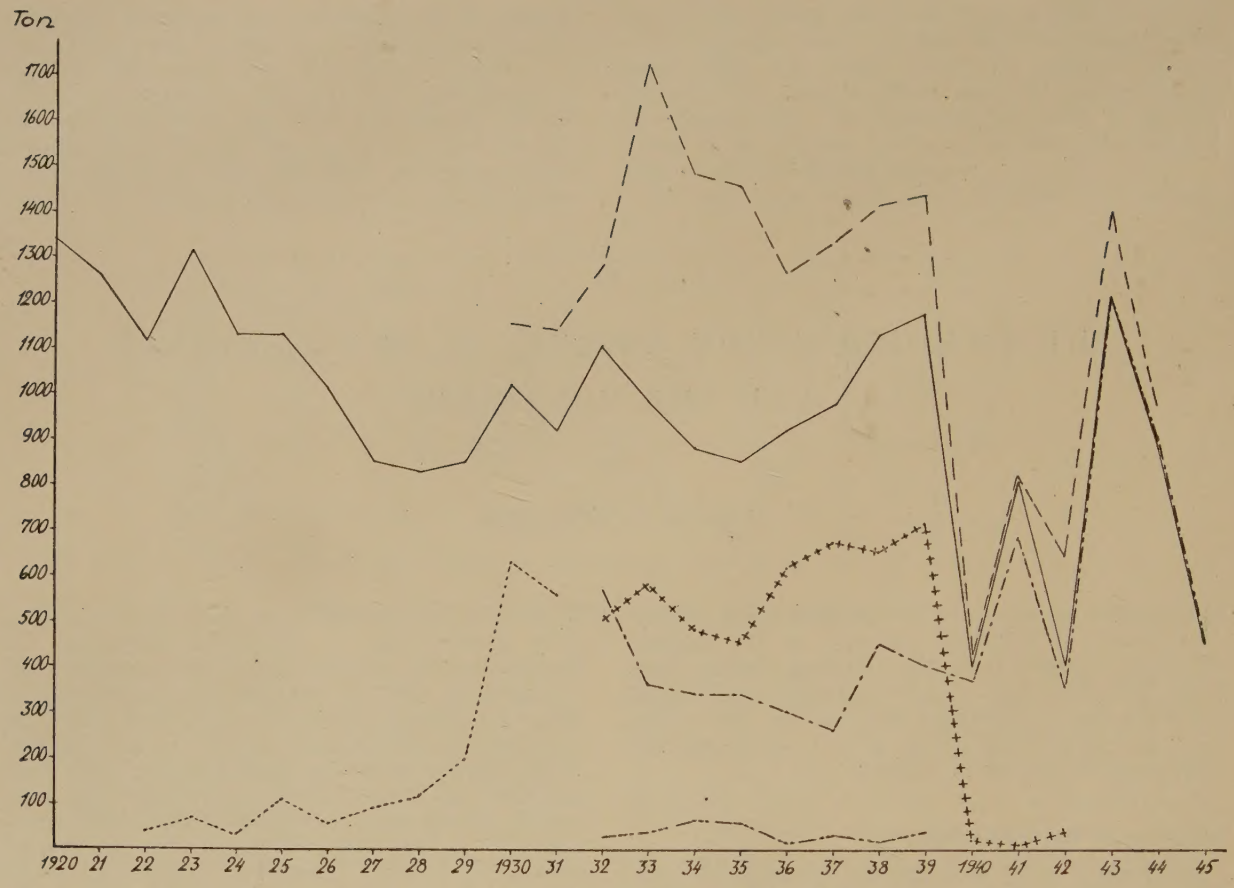

Figure 1. Landings of Witch at Göteborg Fishery Harbour, 1920–1945 ————————
Swedish Witch Fishery, Total Catch 1930–1944 — — — — —
Landings of Witch at Göteborg Fishery Harbour from the North Sea ++++++
Landings of Witch at Göteborg Fishery Harbour from the Skagerak — — — —
Total Catch of Witch in the North Sea 1922–1931 ----------
Landings of Witch at Göteborg Fishery Harbour from Iceland —— — — ——

increase in the catch which took place in the Skagerak during the war *was not due to any increase in the stock.* It is wholly connected with the intensified fishing which was rendered possible by the *abolition of earlier protective and regulating measures.* Above all it is the greatly increased quantities of small witch which characterize the large catches. This confirms the importance to fishing and stock of the minimum size regulations and the fishermen's voluntary regulatory measures. It is also seen that their abolition could lead to an obvious thinning out of the stock in the Skagerak. Without the protective measures the effects of the fishing proved to be too great, and the stock was correspondingly weakened.

In 1946, when the former protective regulations were again applied, the catch figures once more rose appreciably. Landings at Göteborg from the Skagerak totalled no less than 983,990 kilos. Catches of large witch had also increased, both absolutely and as a percentage of the whole. This rather surprising fact is explained, however, by the circumstance that the bulk of the witch reported from the Skagerak was caught off Hanstholm, where a large mine-field prevented all fishing throughout the war. The protection of this area during the war had led to a very abundant stock of witch and a distinct qualitative improvement. This great increase in the stock of witch in this area is explained by the witch's very limited migrations and marked local habits.

Available figures from the witch fishery in 1947, however, suggest that the fishing in the area in question has again deteriorated.

North Sea.

The Swedish North Sea fishing began in the 1920s but did not attain to any great importance until the end of that decade. The fishing was further increased

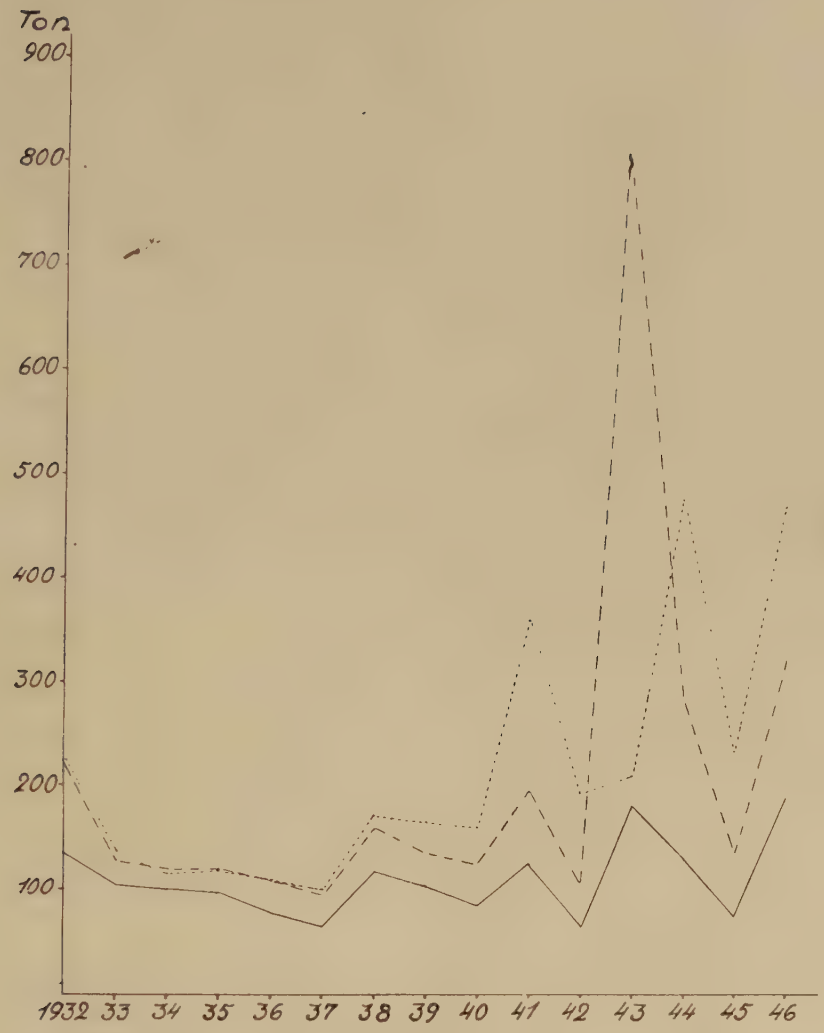

Figure 2. Landings of various Size-Groups of Witch at Göteborg Fishery Harbour from the Skagerak, 1932—1945.
Large —
Medium — — — — —
Small ----------

in the 1930s and it soon surpassed fishing in the Skagerak. No small part of the catch was landed at British ports (Fig. 1).

When Swedish witch fishing began in the North Sea the stock was very rich, with the number of large and medium-sized witch clearly predominant. Along with the increased fishing the character of the catches changed, the number of large witch progressively declining and that of the small fish becoming increasingly predominant. In short, the stock underwent a development from a rather untouched stock to a clearly attenuated one without, however, there being any quantitative deterioration in the fishing (Figs. 4 and 5, see page 12).

The Swedish fishing of witch in the North Sea chiefly took place from Ling Bank to Fladen Ground, by Bressay Ground and Bressay Shoal, and on the Viking Bank.

North Sea fishing was suspended on the outbreak of war. In 1945 it was insignificant and in 1946 only 57,988 kg. were landed at Göteborg from there. According to the fishermen, the North Sea fishing has greatly deteriorated after the war and the witch is not caught on its old grounds.

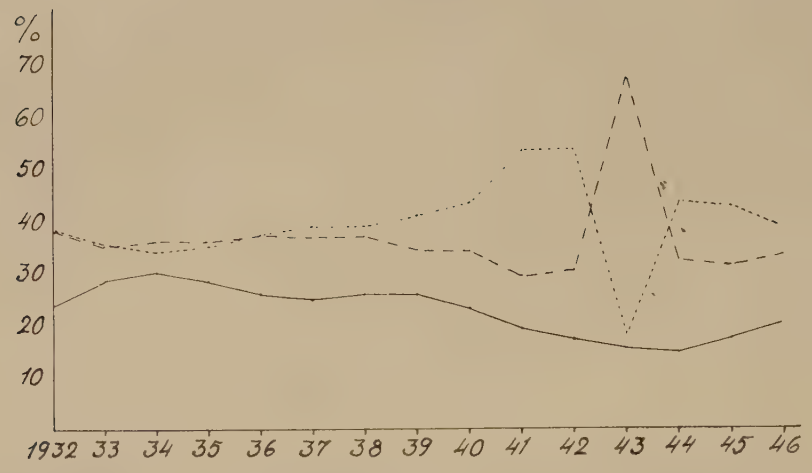

Figure 3. Percentage Distribution of various Size-Groups of Witch landed at Göteborg 1932—1945 from the Skagerak.
Large ————
Medium — — — —
Small - - - - - - - - - - -

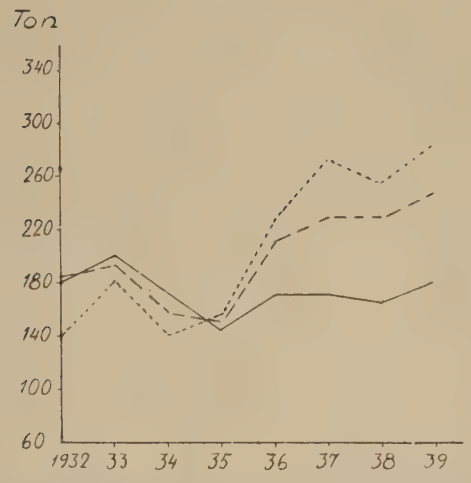

Figure 4. Landings of various Size-Groups of Witch at Göteborg Fishery Harbour from the North Sea 1932—1939.
Large ————
Medium — — — —
Small - - - - - - - - - - -

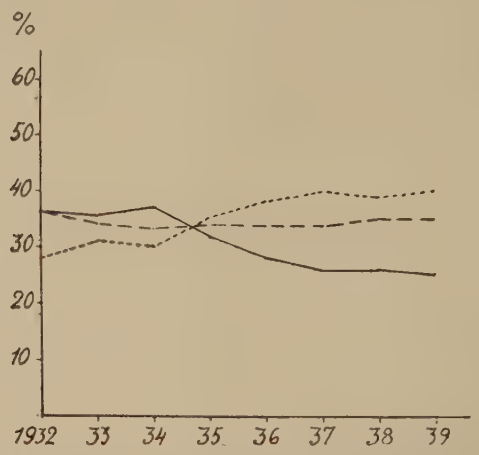

Figure 5. Percentage Distribution of various Size-Groups of Witch landed at Göteborg in 1932—1945 from the North Sea.
Large ————
Medium — — — —
Small - - - - - - - - - - -

3.

THE SWEDISH LING FISHERY BEFORE AND SINCE THE WAR

By

Arvid R. Molander

Swedish ling fishing during the past twenty years (with the exception of the war years) has chiefly taken place in the waters west and north-north-east of the Shetlands and west of the Hebrides. In 1945, the first fishing year after the war, the Swedish vessels confined themselves mainly to the easterly regions of the northern part of the North Sea. Fishing is carried out by means of hooks, the so-called "storbackor".

Year	Catch in tons	No. of Vessels	Catch per Vessel	No. of Fishing Trips	No. of Days Fishing	Catch per Day in kg.
1937....	2,915·7	70	41·7	2	60	*694*
1938....	2,624·2	70	37·5	2	60	*625*
1939....	2,666·0	66	40·4	2	60	*673*
1945....	2,354·2	42	56·0	2	20	*2801*
1946....	3,638·8	64	56·9	2	22	*2587*
1947....	4,749·8	58	81·9	3	35	*2339*

In connection with the above table it should be said that catches in the years 1937—39 were limited by agreement of the fishermen's organization to 45 tons per vessel (22 tons of fresh ling, 25 tons of sea-salted). In 1945 the vessels were permitted to land up to 45 tons of fresh ling and there was no limitation on the salt ling. Nor was there any limitation of the salt ling in 1946, though only 22 tons of fresh ling was allowed. Owing to this limitation of the catches the number of fishing trips has also had to be restricted and they have averaged two. Consequently, pre-war catches were not subject to too violent annual fluctuations; but it should be observed that on the average *60 days fishing* (two trips) were required to obtain the permitted quantities. As a rule, however, these quantities were not fully reached, the quantities *per day's fishing* being no more than 600—700 kg.

Since the war, in other words, the limitation of the catches has not been so great (1945—46) and in 1947 it was entirely given up; the yield per vessel was substantially larger, especially in 1947. But what first attracts attention is the fact that the number of days fishing has so sharply declined. In order to obtain the above-mentioned quantities only 20—35 days fishing of 2—3 trips have been required, against 60 days in the pre-war years, and the catch per day's fishing was about *four times as large*, i. e., 2,3—2,8 tons. It is these figures which show the tremendous increase in the stock of ling during the war years. In the post-war years, according to the fishermen, ling was caught practically everywhere in the fishing area and a shifting of the stock towards the eastern parts of the northern North Sea was plainly evident. It is worth mentioning that ling fishing was taken up in the late summer of 1943 in the area bounded by the Skaw and Hirtshals, where quite unexpectedly relatively large quantities occurred. The catch amounted to 175,6 tons. So much ling has, so far, not been known to be caught by hook in this area for a very long time. In the same region in 1944, 97,6 tons were caught.

If we compare the catch of ling by Swedish trawlers during 1940—45, when this fishing was carried on exclusively in the Skagerak, it will be seen, as set out below, that ling fishing in the Skagerak substantially increased up to 1943 and was still quite good in 1944—45. It is evident that the stock of ling in the Skagerak increased considerably in this period, probably as a result of the complete suspension of fishing in the North Sea.

Year.....	1940	1941	1942	1943	1944	1945
Catch (in tons).	74.3	116.2	108.9	414.6	225.8	217.7

4.

CHANGES IN THE COMPOSITION OF THE FLOUNDER STOCK IN THE GULF OF GDAŃSK DURING THE WAR

By

Z. Mulicki

In the Polish fisheries the flounder occupies one of the more important places. Therefore observations as to its quantity and composition had already been made before the war and a comparison of these with the material collected in the post-war years 1945—47 enables us to obtain information about the changes in the flounder stock, which occurred during the war.

I.

The post-war material was composed of 3,406 flounders from commercial catches in the Gulf of Gdańsk, taken in the period June 1945 to June 1947. The size and weight of the fish, their degree of maturity and their age were determined. These flounders were caught at two different places: 1) in the coastal waters of the Bay of Puck and along the outer coasts of the Hel Peninsula, which constitute the feeding areas of the flounder, 2) in the Deep of Gdańsk, where the flounders are massed during spawning. The coastal catches were taken by means of the cod-trawl with 40 and 35 mm. meshes, the herring-trawl with 25, 20, 18 and 15 mm. meshes, and the eelpout-trawl with 35, 25 and 15 mm. meshes. In the Deep of Gdańsk the cod- and herring-trawls were used.

II.

The total yield of flat-fishes, as shown by the statistical data of the Sea-Fishery Office in Gdynia (Table 1), decreased considerably during the two years preceding the war. The total yield is also seen to have been low during the three post-war years. When, however, we consider the size of the catches, in relation to the number of cutters and boats participating in the fishery, it will appear that the yield is greater now than in 1938 and 1939. In Table 1 the mean quantity of flounders caught by a single

Table 1. The Yields of Flat-Fish in the Fishing Area off Gdynia.

Period	Total Yield (in tons)	Number of Cutters	Number of Boats	Average Yearly Catch per Cutter (in tons)
1931—32	776	125	717	3·9
1933—35	760	164	631	3·3
1936	757	162	857	3·0
1937	940	160	775	3·9
1938	342	142	708	1·6
I—VIII 1939	224	142	708	1·4
VI—XII 1945	163			
1946	374	740 70	397	3·4
I—VI 1947	203			

cutter was calculated on the assumption that the catching capacity of 10 rowing boats is equal to that of one sea-fishery motor cutter.

The changes in the quantity of flat-fish caught are mainly related to the flounder, since this fish constitutes the majority of the Polish catches. The remaining species, namely plaice, dab and turbot are of minor importance. Table 2 illustrates the quantitative

Table 2. Percentage Composition of Flat-Fish Catches according to Species.[1])

Period	Flounder	Dab	Plaice	Turbot
1922—24	60	25	10	5
1927—29	59	36	2	3
1930—35	80	13	2	5
1936—37	90	4	2	4
1938—39	90	3	+	7
1945—47	86	+(0·4)	12	2

[1]) 1922—39: according to reports of the Polish Sea-Fishery Office, 1945—47: according to the analysis of catches.

relationship between these 4 species in the period 1922—1947.

The decrease in dab in the later years, especially in the post-war period, and the increase in the plaice percentage are worth mentioning.

III.

The post-war changes in the composition of the flounder catches have been considerable with regard to both the size and age of the fish. A comparison of the post-war catches with the material of 1937 worked out by W. Cieglewicz (1938), and with the material of 1938 by Cieglewicz and Mulicki (1948), is shown in Tables 3—5 and Figures 1 and 2.

The size of flounders caught after the war (Fig. 1) increased greatly in comparison with that observed in 1937—38. The mean length of the flounders caught in the coastal waters after the war reached 25·1 cm. in length, as against 20·2 cm. in 1937—38. The figures for the flounders caught in the deep waters on the spawning ground are 29·2 cm. in 1945—47 and 24·3 cm. in 1937—38, respectively. In both cases the mean length increased by 5 cm. compared with that of 1937—38. During the last two pre-war years, the greatest percentage of flounders caught in the Bay of Puck and in the coastal waters of Hel, were 18 cm. long, while those in the Deep of Gdańsk were 20 cm. At present fish of 24—25 cm. in length are dominant in the coastal catches, while in the Deep, fish of 28—30 cm. constitute the dominant length-class.

The age composition of all Polish flounder catches in the Gulf of Gdańsk is represented by Table 5 and Figure 2.

Table 3. Size and Age of Flounders caught in Coastal Waters.

Length in cm.	1945—47 Age-Groups II	III	IV	V	VI	VII +	total	%	1937—38 total	%
18.....	3	34	24	2	—	—	63	3·5	1630	30·3
19.....	2	47	43	3	—	—	95	5·3	1369	25·4
20.....	3	58	52	11	—	—	124	6·9	847	15·7
21.....	1	45	53	12	—	—	111	6·2	447	8·3
22.....	2	60	62	16	—	—	140	7·8	346	6·4
23.....	1	56	80	20	1	—	158	8·8	182	3·4
24.....	—	48	90	29	2	—	169	9·4	112	2·1
25.....	—	31	100	33	5	—	169	9·4	102	1·9
26.....	—	20	88	32	11	2	153	8·5	80	1·5
27.....	—	4	66	54	15	1	140	7·8	70	1·3
28.....	—	3	55	43	12	6	119	6·6	59	1·1
29.....	—	1	39	31	9	1	81	4·5	58	1·0
30.....	—	1	32	35	13	2	83	4·6	31	0·6
31.....	—	—	16	23	9	4	52	2·9	24	0·4
32.....	—	—	15	26	7	6	54	3·0	5	0·1
33.....	—	—	1	13	3	3	20	1·1	5	0·1
34.....	—	—	1	7	4	4	16	0·9	5	0·1
35.....	—	—	5	10	4	4	23	1·2	10	0·2
36.....	—	—	1	3	3	2	9	0·5	3	0·1
37.....	—	—	—	3	1	1	5	0·3	—	—
38.....	—	—	—	1	—	3	4	0·2	—	—
39.....	—	—	—	1	2	4	7	0·4	1	+
40.....	—	—	—	—	1	—	1	0·1	—	—
42.....	—	—	—	—	—	1	1	0·1	—	—
1945—47 total	12	408	823	408	102	44	1797			
1945—47 %	0·7	22·7	45·8	22·7	5·7	2·4		100·0		
1945—47 average length 25·1 cm.										
1937—38 total	938	2332	1420	512	132	52			5386	
1937—38 %	17·4	43·3	26·4	9·5	2·4	1·0				100·0
1937—38 average length 20·2 cm.										

Table 4. Size and Age of Flounders caught in the Deep of Gdańsk.

Length in cm.	1945—47 Age-Groups III	IV	V	VI	VII +	total	%	1937—38 total	%
18.....	5	—	—	—	—	5	0·3	192	5·7
19.....	1	3	—	—	—	4	0·3	238	7·0
20.....	7	1	1	—	—	9	0·6	308	9·1
21.....	8	3	2	—	—	13	0·8	293	8·6
22.....	13	10	4	—	—	27	1·7	314	9·2
23.....	24	21	3	—	—	48	3·0	304	9·0
24.....	31	29	3	—	—	63	3·9	302	8·9
25.....	28	55	12	1	—	96	6·0	271	8·0
26.....	18	65	24	4	—	111	6·9	262	7·7
27.....	13	61	60	10	2	146	9·1	229	6·7
28.....	7	72	82	18	2	181	11·2	159	4·7
29.....	4	58	62	29	8	161	10·0	146	4·3
30.....	2	50	80	32	9	173	10·7	124	3·7
31.....	2	33	63	35	10	143	8·9	65	1·9
32.....	—	32	63	31	11	137	8·5	55	1·6
33.....	—	14	39	25	11	89	5·5	39	1·1
34.....	—	10	27	21	8	66	4·1	27	0·8
35.....	—	4	13	17	4	38	2·4	16	0·5
36.....	—	2	17	12	9	40	2·4	17	0·5
37.....	—	—	2	9	6	17	1·1	10	0·3
38.....	—	—	2	9	7	18	1·1	10	0·3
39.....	—	—	2	5	6	13	0·8	6	0·2
40.....	—	—	1	1	4	6	0·4	5	0·1
41.....	—	—	—	—	1	1	0·3	—	—
42.....	—	—	—	—	1	1		—	—
43.....	—	—	—	—	2	2		1	0·1
44.....	—	—	—	—	—	—		1	
53.....	—	—	—	—	1	1		—	—
1945—47 total	163	523	562	259	102	1609			
1945—47 %	10·1	32·5	35·0	16·1	6·3		100·0		
1945—47 average length 29·2 cm.									
1937—38 total	433	974	1264	432	291			3394	
1937—38 %	12·8	28·7	37·2	12·7	8·6				100·0
1937—38 average length 24·2 cm.									

IV.

Conclusions. On the basis of the above-mentioned data, we shall characterize the present flounder catches in the Gulf of Gdańsk and those of the period 1937—38, and make a comparison between them.

1. The 1937—38 catches are characteristic as to:—

a) a rapid decrease in catches (from 940 tons in 1937 to 342 tons in 1938),

b) a low mean length of fish (21·7 cm.),

c) a large percentage of young fish (II group — 18·7 %, III group — 31·5 %).

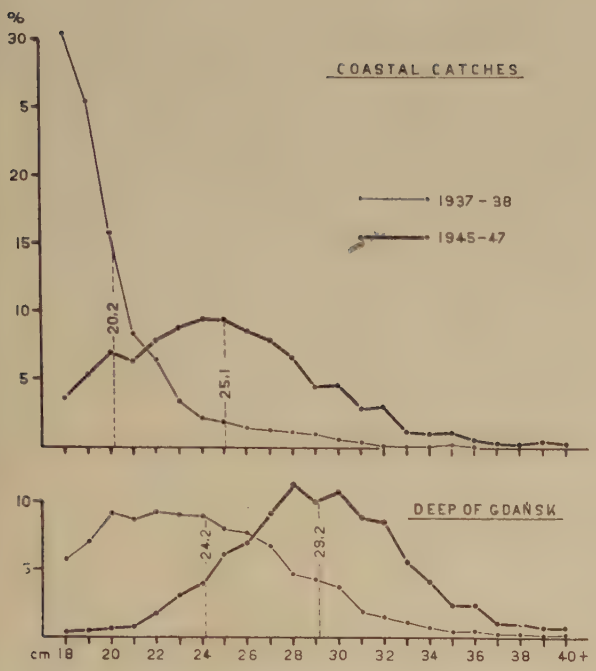

Figure 1. The Size-Composition of Flounder Catches in the Gulf of Gdańsk.

Such a state, according to E. Fischer (1939), P. F. Meyer (1939, 1941), E. S. Russell (1939) and others, may be described as a state of overfishing of the stock. This overfishing of the flounder stock in the Gulf of Gdańsk was not a new event in the Baltic Sea. It occurred, as stated by Meyer (1939, 1941) as early as 1935 in the neighbouring region of Bornholm.

2. The 1945—47 catches show:—

a) increased yields (from 1·4 tons yearly per cutter in 1939, to 3·4 tons),
b) a high mean length of fish (27·1 cm.),
c) a large percentage of older fish (IV + V groups — 68 %, II + III groups — 17·1 %).

The post-war state of catches indicates an improvement in the stock. Bearing in mind, however, the future expansion of the fishing fleet and along with it, an increase in fishing, a return of overfishing is to be feared. The more so because the recruitment of the young generation is not so great as in the years when fishing was limited to the coastal catches by the use of passive gear. Observations on the density of eggs and larvae, caught during the spawning period in the Deep of Gdańsk with quantitative Hensen-nets, illustrate this:—

29 III	1909	— 87	eggs	— 0	larvae	Apstein (1911),
11 IV	1947	— 21	,,	— 0	,,	W. Mańkowski (unpublished data).
9 V		— 24	,,	— 5	,,	
9 V		— 0	,,	— 1	,,	
29 V		— 1	,,	— 5	,,	

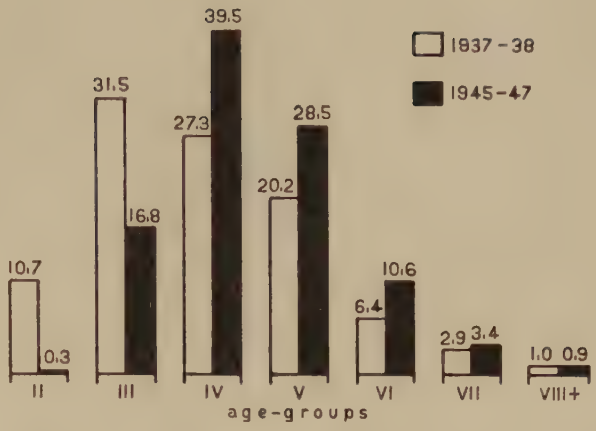

Figure 2. The Age Composition of Flounder Catches in the Gulf of Gdańsk.

The replenishment of fry is also threatened by the intensified trawling for cod in the Deep of Gdańsk which in recent years has been the principal object of Polish fishing. Together with the cod, a great number of flounders, gathered there for spawning, is caught and this reduces the potential number of fry.

The existing measures for protection appear to be insufficient, and it therefore seems necessary to increase the protection of the flat-fish, not only by raising the minimum size of fish, but also by the periodical prohibition of fishing on the spawning grounds.

Table 5. Age Composition of all Polish Flounder Catches in the Gulf of Gdańsk.

Age-Groups	II	III	IV	V	VI	VII	VIII +	total
				1937–38				
No. of Fish .	938	2765	2394	1776	564	253	90	8780
%.....	10·7	31·5	27·3	20·2	6·4	2·9	1·0	100·0
				average length = 21·7 cm.				
				1945–47				
No. of Fish .	12	571	1346	970	361	116	30	3406
%.....	0·3	16·8	39·5	28·5	10·6	3·4	0·9	100·0
				average length = 27·1 cm.				

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5.

THE STOCKS OF PLAICE IN THE NORTH SEA AND THE TRANSITION AREA DURING THE WAR

BY

AAGE J. C. JENSEN

I. The North Sea.

Changes in the Fishing Intensity and Fishing Grounds.

The trawl fishery was very much reduced on most of the grounds. It was confined practically only to some coastal areas, and in most countries the number of trawlers was very much reduced. One of the few reports as yet available on the extent of this fishery comes from Holland[1]). According to BAERENDS the capacity of the Netherland fishing fleet decreased during the course of the war to a much greater extent than the number of trawlers.

In Denmark the capacity of the fleet fishing with the Danish seine increased by about 10 % because some new cutters were built (Table 1).

Table 1. Number of Danish Cutters over 15 B.R.T. in the North Sea and Number of Landings in Esbjerg and Thyborøn.

Year	Cutters 15–50 B. R.T.	> 50 B. R.T.	Landings in Esbjerg live	Landings in Esbjerg iced	Landings in Thyborøn
1936.....	388	3	4369	4736	6553
1937.....	386	4	5179	4817	8292
1938.....	398	4	4740	4063	8083
1939.....	422	4	6938	4275	7722
1940.....	408	3	3738	3933	4861
1941.....	424	3	1766	5231	4157
1942.....	461	5	230	5188	2509
1943.....	438	1	502	6948	2665
1944.....	453	3	745	4861	1953
1945.....	503	10	1503	2709	1583
1946.....	541	11	1208	5441	4484

[1]) G. P. BAERENDS: A survey of the Dutch fishery for Demersal Seafish in the Years 1939—1935. Ann. Biol. II. p. 60.

The number of landings of iced plaice at Esbjerg in 1943 was considerably above that of the pre-war years, but in each of the other years of the war it was about the same as in pre-war years. The number of landings of live plaice decreased very much. The number of landings at Thyborøn was very low during the war.

The Danish fishery was also mainly restricted to the coastal grounds because the cutters could not venture far from the nursery grounds off Esbjerg, without the risk of being fired on from both German and allied quarters.

It is beyond doubt, (1), that the total fishing capacity of the fleet exploiting the stock of plaice was less than normal, and (2), that to a much greater degree than usual the fishery was confined to the coastal areas and in particular to the nursery grounds of the young plaice.

The Weight Yield of the Plaice Fishery.

It is of great importance to note that the enormous increase in the yield of the Danish plaice fishery was by no means due to a neglecting of other fisheries (especially for cod and haddock).

In some periods of former years an increase in the yield of the plaice fishery coincided with a decrease in the other fisheries, owing to the fact that the cutters may prefer to fish for the species giving the best economic yield.

It is also obvious that the stocks of cod and haddock have improved very much during the war, and that the Danish fishermen have obtained increasingly catches of these species simultaneously with the increasingly greater catches of plaice (cp. Table 3).

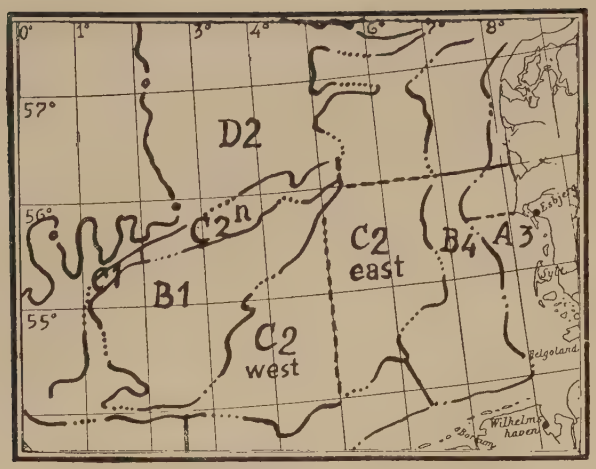


Figure 1. Areas surveyed in the paper.

In 1939 the total yield of plaice may have been somewhat less than normal, but the two years 1940 and 1941 together will probably have totalled about 30—35 mill. kg. below the normal.

In 1942, however, the yield may be assumed to have been a little above the normal, in 1943 about 20 mill. kg. more, in 1944 somewhat above the normal and in 1945 considerably, perhaps 15 mill. kg., above the normal.

Judging from our present knowledge of the yield of the fishery during the war it seems that on an average the North Sea during these years yielded a little more than the normal weight of plaice.

Changes in the Stock.

1. The density of the stock increased in all areas (Figure 2) though not so much in the coastal areas where the most intense fishery was carried on.

2. The age distribution reflects on the one hand the frequency of the year-classes, on the other the change in the fishing intensity.

The number of the 0-group plaice in the Danish Waddensea during the years since 1933 has been examined by TÅNING who found that the following numbers were caught per hour's fishing[1]):

Year	Number	Year	Number	Year	Number
1933	53	1938	71	1943	176
1934	42	1939	352	1944	74
1935	151	1940	228	1945	211
1936	277	1941	334		
1937	416	1942	41		

The number found in 1937 was the same as that found by JOHANSEN for the 0-group of the very rich 1922 year-class. It is also seen that the 1936 and 1939—41 year-classes were rich or very rich.

Corresponding with these rich year-classes, preceded and followed by poor or rather poor year-classes, the age of the plaice was low during the first years of war and increased during the war (see Fig. 3).

The rather small amount of plaice of the rich year classes 1936 and 1937 caught from each of the areas must be due to the intense fishing on the nursery grounds during the war. In the outermost areas there seems to have been some accumulation of old plaice but this was by no means very marked.

3. The quality of the plaice in all areas improved during this war to nearly the same extent as during the 1914—18 war. The number of big plaice increased in proportion to the number of small ones. This is seen in Fig. 4 where the percentage distribution in 5-cm. groups of plaice above 27 cm. is shown. For comparison, this minimum size limit has been used in all years, because during this war most of the plaice below 27 cm. were rejected onboard. The mesh-size of the Danish seine was increased at the same time.

The change is a result of the fishing intensity and of the density of the stock. Characteristic differences are therefore found between the developments in the different areas.

[1]) Å. VEDEL TÅNING: Observations on Young Plaice in the Danish Waddensea during the war. Ann. Biol. II, 1947, p. 53.

Table 2. Weight Yield (in mill. kg.) of the Plaice Fishery in the North Sea.

	Belgium	Denmark	England	Germany	Holland	Norway	Scotland	Sweden	Total
1931—34	3·2	16·9	17·8	2·5	7·5	0·1	1·7	1·4	52·2
1935—38	3·1	13·6	15·6	1·8	8·1	0·1	3·0	0·6	46·7
1939	2·5	c.16·3	?	?	7·1	?	2·2	1·2	29 + ?
1940	?	18·4[1])	?	3·0	2·4	?	2·3	0	26 + ?
1941	0·1	29·3[1])	?	2·2	4·5	?	2·0	0	38 + ?
1942	0·9	38·7[1])	?	5·1	4·5	?	2·5	0	52 + ?
1943	1·8	52·2[1])	?	6·5	5·9	?	2·2	0	69 + ?
1944	0·6	33·0[1])	?	5·5	4·8	?	2·4	0	46 + ?
1945	7·0	34·9	?	?	?	?	5·2	2·0	49 + ?
1946	?	37·3	29.3	?	?	?	5·8	?	72 + ?

[1]) The landings in England are not included. In each of these years they barely reached about 0.1 mill. kg.

Table 3. Yield of the Danish Fishery for Plaice, Cod and Haddock from Esbjerg and Thyborøn (in mill. kg.).

Year	Plaice		Cod		Haddock	
	Esbjerg	Thyborøn	Esbjerg	Thyborøn	Esbjerg	Thyborøn
1936	8·7	1·1	0·8	0·8	1·0	0·5
1937	8·0	2·5	1·4	0·7	1·3	0·7
1938	9·7	2·7	0·9	0·7	0·6	0·4
1939	10·0	2·6	1·9	1·0	0·2	0·5
1940	14·3	2·6	1·1	0·8	0·03	0·6
1941	23·4	3·0	2·4	1·7	0·4	1·3
1942	30·3	3·9	4·2	1·2	0·4	0·6
1943	46·2	4·6	5·0	2·2	0·6	1·9
1944	27·6	4·6	5·9	1·4	5·4	3·6
1945	13·9	2·1	2·4	0·6	0·5	0·9
1946	12·1	2·8	6·7	2·5	2·9	3·0

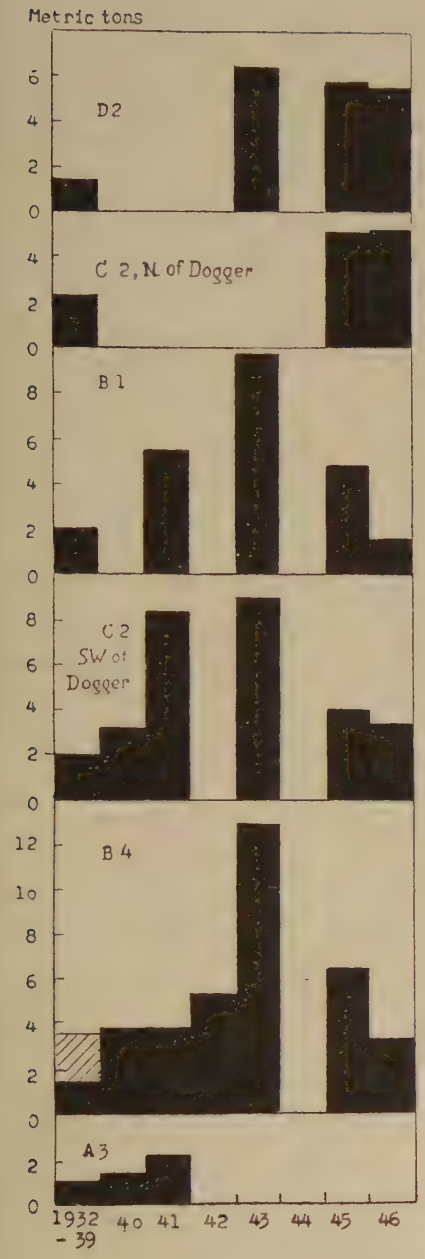


Figure 2.

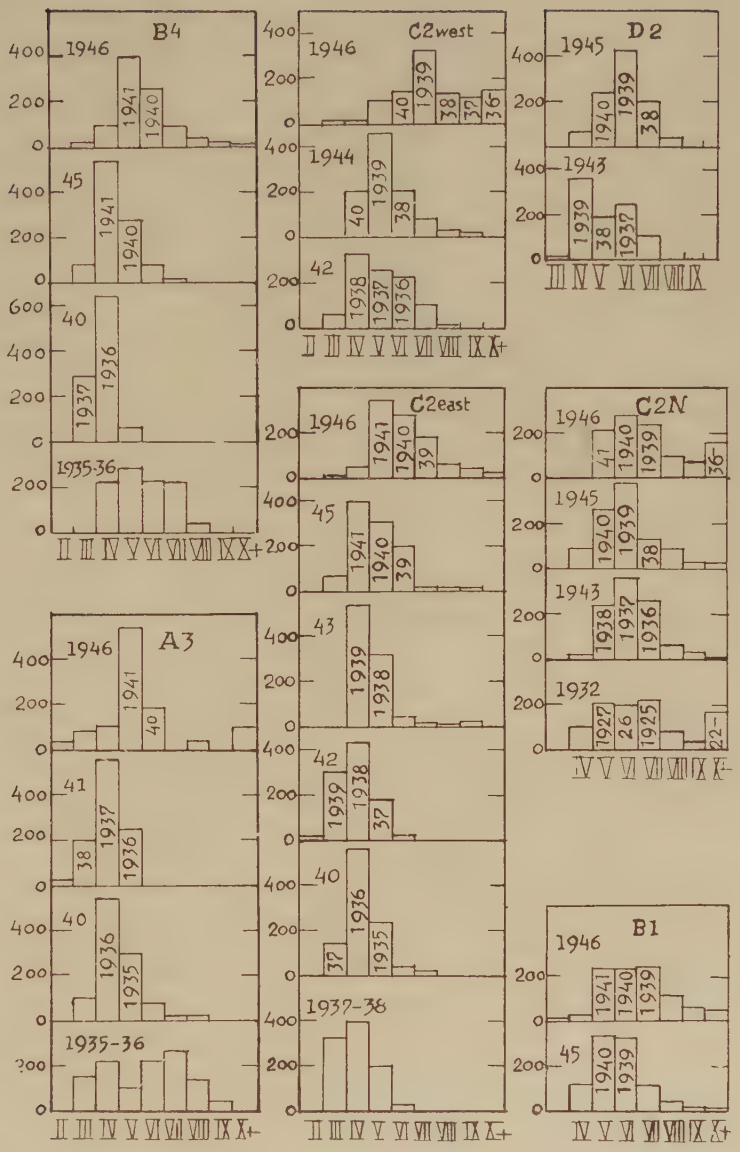


Figure 3.

Figure 2. Mean Landings of Plaice by cutters at Esbjerg.

From area B 4 the landings before the war consisted mostly of live plaice, yet some large landings of iced plaice occurred (partly of more than 10 tons). In the black column of 1932–39 only the landings of live plaice are given, the black and hatched columns together show the mean of all catches. In the area C 2, N. of Dogger some catches from the neighbouring area C 1, N. of Dogger are included.

Figure 3. Age Distribution of Plaice above 27 cm. (Permille).

In some of the columns the year-classes are noted.

In A 3 off Esbjerg in depths of less than 20 m. no change was found during 1940 and 41. Here the fishing intensity was so great that the size composition remained at the same level, although the recruitment to the stock must have been unusually great owing to some very rich year-classes (see above). In this area, when the Danish cutters in the first years of 1914—18 war took only about $^1/_3$ of the weight

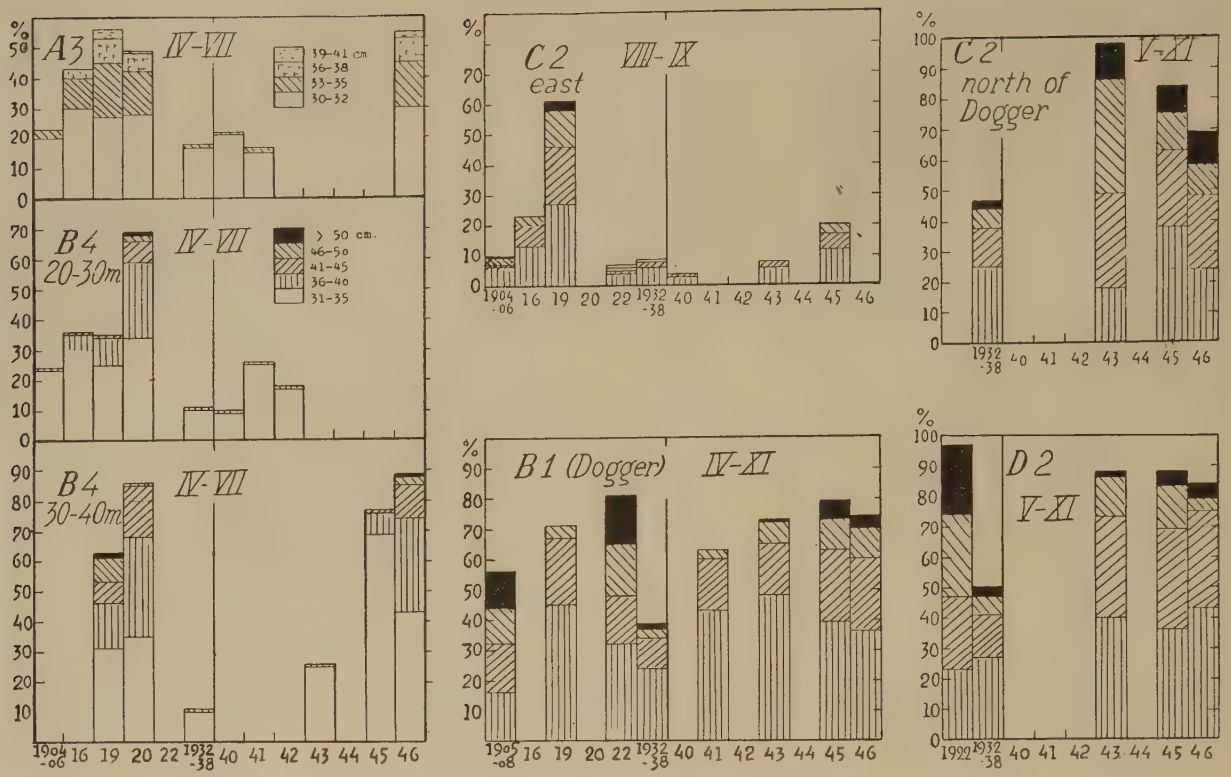


Figure 4. Length Distribution of Plaice above 27 cm.

For the area A 3 the 3 cm. length-groups above 31 cm. have been shown. For the other areas the 5 cm. groups are shown, for B 4 above 31 cm. for B 1, C 2 and D 2 above 36 cm. The Roman numerals indicate the months.

landed during the first years of this war, a marked change had already occurred in 1916.

In 1946 the fishing intensity in A 3 was rather small. The landings of live plaice (fished mostly in A 3 and B 4) were very few, and the fishery landing iced plaice was carried out on more distant grounds. Corresponding to this, and also because of the fact that the plaice from the rich year-classes were now more than five years old, the size composition was almost exactly the same as in 1920.

In B 4 the size composition was also not essentially altered until 1943 owing to the intense fishery. Yet the fishing in this area was very much more irregular than in A 3, especially in depths above 30 m. Therefore in some catches from this area the proportion of big fish had increased very much, while in other catches there was no change at all. In 1946 the size composition was about the same as in 1920. In those parts of C 2 situated to the south-east of the Dogger Bank the size composition had changed very much in 1943. The fishing in this area was rather heavy during 1944 and 1945 and moreover the recruitment from the nursery grounds during the war must have been restricted by the intense fishery on these grounds. Therefore the size composition here did not change so much as in 1919.

On the Dogger Bank the reduction in the fishing had already produced a very great change in 1941, when more than half the catch consisted of plaice of more than 36 cm. This development continued until 1945, while in 1946 a slight reversal towards the state of 1932—38 was found.

North of the Dogger the change had already reached its highest point in 1943 (or 1944) while a slight reversal towards the state of 1932—38 had begun in 1945 and continued in 1946.

Even on the nursery grounds there were some comparatively old plaice in a few of the catches, but in most cases the plaice here were very young until 1945.

4. The mean length of each age-group increased on many of the grounds (see Fig. 5). The mean length of the age-groups depend mainly on fishing intensity and growth. In the areas most intensely worked by the fishery (A 3) the steady removal of the bigger fish kept the size of the age-groups at the pre-war level until the fishing on these grounds diminished immediately after the war, — then the mean lengths of the age-groups rose at once. On the less intensely worked outer grounds as far as the Dogger Bank the mean lengths of the age-groups rose continuously during the war. North

of the Dogger Bank the mean length increased from the pre-war years until 1943 but decreased from 1943 to 1945—46. This decrease may be ascribed to overpopulation in these areas which were almost completely spared by the fishery during the war. Yet the mean lengths in 1945—46 seem to have been the same as, or greater than, in 1932—38 (when their comparatively low size was due to intense fishing).

As regards the growth-rate, the changes are distinctly different from those found during the 1st world war. At that time the greatly reduced fishery over the whole of the open North Sea caused very pronounced overcrowding, accompanied by a greatly reduced growth-rate (though this reduction of growth, as shown by BÜCKMANN, was not so great as was sometimes believed). The supposition is undoubtedly correct that the reduced growth-rate at that time was due to the rapidly rising competition for food within the dense stock. The increased lengths of the age-groups observed during this war seem to have been due to the diminished fishing intensity, as explained above. Normally fishing will remove from each age-group firstly the fastest growing fish when they pass the minimum size, and thereafter mostly the biggest of the grown-up fish in each age-group because they will frequent the spawning grounds one year or more before the smaller fish of the same age-group. Normally the plaice is fished most intensely on the spawning grounds.

It is very characteristic that the plaice of the rich

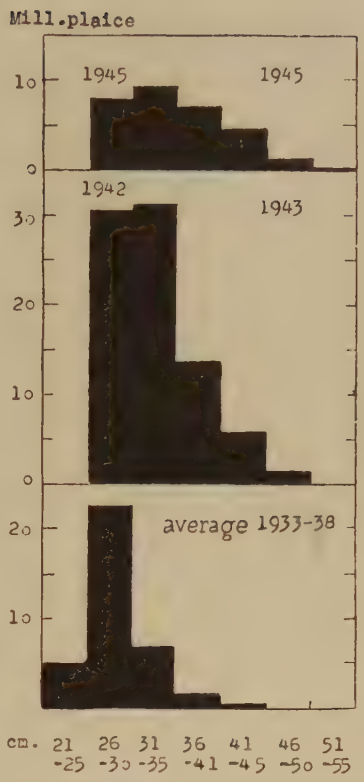


Figure 6. Total Number of Plaice landed at Esbjerg.

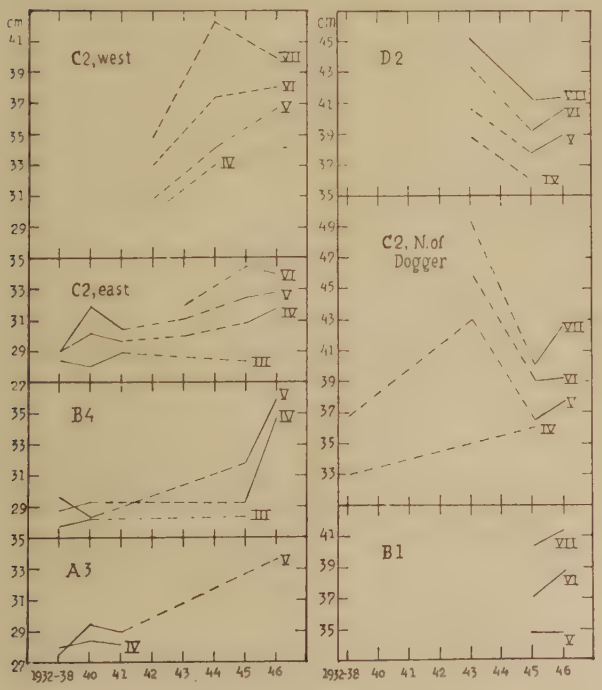


Figure 5. Mean Lengths of the Age-Groups (Plaice above 27 cm.).

year-classes, (especially 1939) that have formed the stock of market fish in the North Sea have not shown a very low growth-rate.

From the change in the mean lengths of the age-groups we must draw the conclusion that the density of the stock has not been great enough to affect the growth-rate of the plaice to a perceptible degree, or rather, that a possible diminution of the mean length due to the more dense population is outweighed by the increase in the mean lengths due to less fishing.

Length Distribution and Number of Plaice, caught from Denmark.

The length distribution of the total Danish catch has changed during the war mainly corresponding to the change of the length distribution of the plaice on the fishing grounds (see Fig. 6).

Table 4. Number, in millions, of Plaice landed at Esbjerg.

Year	Number	Year	Number	Year	Number
1933	47	1936	30	1942	83
1934	50	1937	31	1945	31
1935	34	1938	31		

It appears from Table 4 that the number of plaice caught did not increase nearly as much as the weight

yield of the fishery owing to the improvement in the quality of the fish landed.

The most remarkable result is that a heavier weight yield per fishing unit and *a greater total weight yield* could be reached by *a decreased fishing intensity* because the Danish-seine fishery became dominant. This is the more remarkable because the utilization of the stock was unfavourable inasmuch as the young fish on the nursery grounds were exploited much too heavily.

II. The Transition Area.

Changes in the Fishery.

During the whole of the war many areas were inaccessible to the fishermen on account of mine fields etc., particularly in the Skagerak, the Kattegat and the Belt of Langeland. Only very limited areas could safely be fished.

Within the free areas fishing was sometimes very intense, but in certain localities of the Belt Sea the plaice fishery was no doubt somewhat limited because the stock of plaice was very small; it should be remembered, however, that under normal circumstances several species of fish are fished for at the same time.

In the Transition Area the capacity of the fishery for plaice cannot be measured by the number of cutters to the same degree as in the North Sea where fishing for plaice is by far the most important. In the Transition Area fishing for many other species of fish especially herring, cod, flounder and dab, is very important for the fleet. Yet it may be significant to note that no change in the number of cutters occurred before 1943 and that a real increase was found only in 1945 and 1946. The number of nets available for plaice fishing decreased during the war.

The Weight Yield of the Plaice Fishery.

The most remarkable fact is that the total yearly weight taken from the areas in 1939—46 was only in some few years — and then especially in the Sound — below the average of the pre-war years, but in most of the years it was even much higher.

In the Kattegat a very great rise in the yield occurred in 1945 and 1946, and in the Belt Sea a minor increase was found in 1946.

Table 5. Weight Yield (in mill. kg.) of the Plaice Fishery in the Transition Area.

	Denmark				Sweden
	Skagerak	Kattegat	Sound	Belt Sea	Skagerak-Kattegat
1931—34.....	1·4	2·5	0·1	0·9	0·5
1935—38.....	1·4	3·0	0·06	1·0	0·5
1939.....	1·4	3·2	0·05	1·0	0·5
1940.....	1·6	2·9	0·06	1·7	0·6
1941.....	2·7	4·1	0·07	1·8	0·9
1942.....	1·8	3·6	0·07	1·1	0·9
1943.....	1·8	3·3	0·08	1·0	1·1
1944.....	2·4	4·0	0·05	0·6	0·8
1945.....	0·9	7·8	0·07	0·8	—
1946.....	1·7	12·0	0·1	2·7	—

Changes in the Stock of Plaice.

The length distribution of the catch has been reviewed in Ann. Biol. In the northern Kattegat in most cases it remained unchanged in the areas nearest to the coast, but in depths of about 20 m. and more, the size of the plaice increased until 1943, no doubt due to the accumulated stock of large plaice spreading to the neighbouring areas. From 1943 to 1945 the size of the plaice caught decreased, presumably on account of the very intense fishery carried on in the very restricted areas which were free from mines. From 1945 to 1946 it increased again when the fishing intensity on these grounds was diminished by the gradual opening of the closed areas to the fishermen.

In the central and southern Kattegat and in the Belt Sea the length distribution of the plaice caught

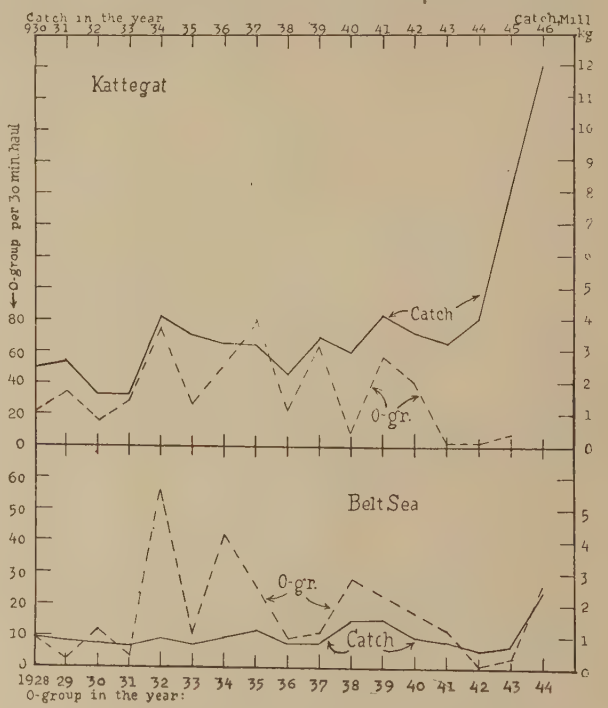


Fig. 7. Danish Catch of Plaice in the Kattegat and the Belt Sea, respectively, compared with the mean number of 0-Group plaice caught by the Johansen young-plaice trawl 2 years before.

increased until 1945 on account of some very poor year-classes (Fig. 7). In 1945 and 1946 the rich year-class 1944 entered the fishery and lowered the length distribution (in 1945, however, in the Kattegat only, at depths below 20 m., and at some coastal grounds deeper than 20 m.).

Causes of the Changes in the Yield.

During the war the weight yield in the Kattegat was a little higher than in pre-war years. This was because of the improvement of the stock, due to the large plaice spreading to the fishing grounds from the accumulated stock on the grounds closed to fishing.

From Fig. 7 it appears that the fluctuations from year to year in the yield of the plaice fishery in the Kattegat down to 1943 chiefly follow the fluctuations of the number of the 0-group found two years earlier. In 1944, however, the catch was above normal despite the very poor 1942 year-class, and in 1945 the catch was more than double of that of the previous years despite the fact that the 1943 year-class also was very poor.

In the northern Kattegat, the fluctuations in the number of the 0-group are of greater importance for the size of the stock in the years that follow than in the southern Kattegat, where the number of the 0-group is generally much smaller than in the northern Kattegat. Most unfortunately the investigations of the number of the 0-group plaice in the northern Kattegat had to be discontinued in 1944 and 1945.

In the southern Kattegat 16 fish of the 0-group was the average per 30 min. haul in 1944, i. e., somewhat more than the average in 1927—45 (13 per 30 min.).

Also the Swedish coastal investigations were discontinued in 1944, but in 1945 the following number of the I-group were caught per 30 min. haul:—

	1945	Mean 1929–38
Skagerak.....	16	9
Central Kattegat ...	3	14
Southern Kattegat..	1	8

There is thus no evidence whatever of the 1944 year-class having been extraordinarily numerous. In fact, the strength of the 1944 year-class seems to have been of the same order as that of the good year-classes of the 1930's.

In 1945 an age analysis was carried out in November on plaice caught in the Aalbæk bay (S. of the Scaw) at a depth of 9—10 m. The percentage age composition was:—

II-group,	year-class 1943	68 %
III-group,	— — 1942	26 %
IV-group,	— — 1941	6 %

In Jan. 1947 a sample of plaice caught to the north of the Scaw at a depth of 45 m. had the following age composition:—

II-group,	year-class 1944	15 %
III-group,	— — 1943	22 %
IV-group,	— — 1942	2 %
V-group,	— — 1941	3 %

Thus do neither these analyses from the commercial fishery give evidence of the 1944 year-class having been so abundant that it could cause the enormous rise in the Kattegat yields in 1945 and 1946.

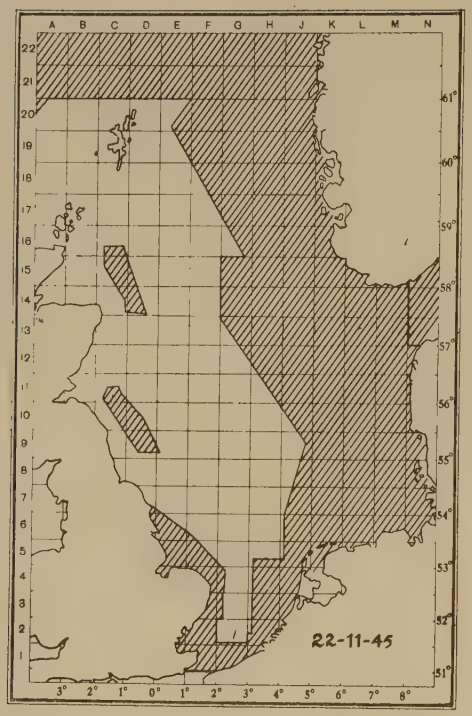
As mentioned above the decrease in the mean lengths of the plaice caught in 1945 in the central and southern Kattegat, at depths less than 20 m. and also in 1946 — must be due to the good 1944 year-class which followed the poor year-classes of 1941—43. Yet in 1945 and 1946 the average lengths were still some cm. higher than in 1940 indicating that the older and larger plaice continued to play an important rôle for the fishery.

On the basis of these investigations we must conclude that the enormous rise, in the yield of the Kattegat plaice fishery in 1945 and 1946 is not essentially due to the good year-class 1944, but must be ascribed mainly to the gradual opening of the areas closed during the war, and the continued spreading to other grounds of the large plaice accumulated on the closed grounds.

In the Belt Sea the yield decreased until 1944—45, corresponding with the strength of the year-classes (comp. Fig. 7).

The rise in the yield in 1946 in this area was not very much greater than would have been expected from the good 1944 year-class. Yet, it is somewhat greater, and the market measurements of the Danish Biological Station show clearly that in some places the quality of the plaice caught was improved by large and old plaice which must have come from the areas closed to the fishery during the war, and which are still partially closed.

It is of outstanding practical interest that the very much overfished stock of the Kattegat could be improved to such a degree by the closing of some areas, that it could give to the Danish fishery in 1946 4 times the average pre-war catch. It must be remembered that during the preceding years of war it yielded more than the normal.



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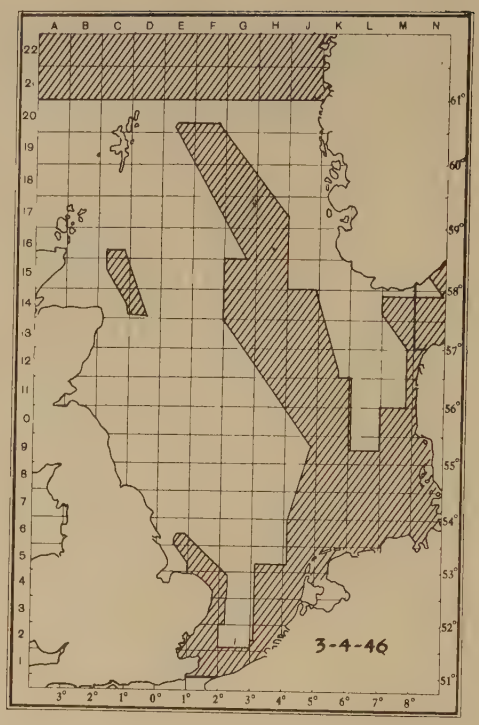

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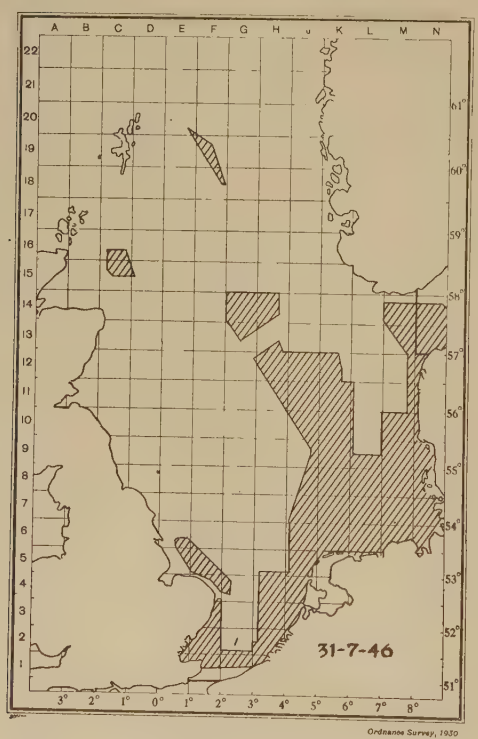

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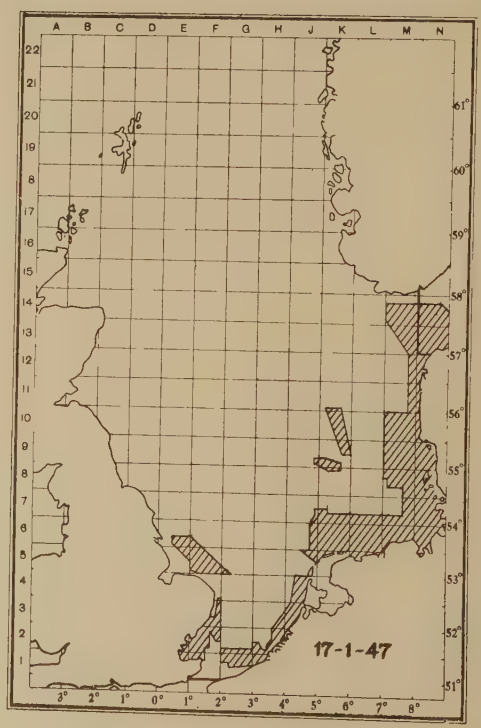


Chart 4.

Figure 1. Charts showing areas of the North Sea in which fishing was prohibited (shaded areas) on dates indicated.

6.

THE EFFECT OF THE 1939–1945 WAR ON THE ENGLISH NORTH SEA TRAWL FISHERIES

By

A. R. Margetts and S. J. Holt

Introduction.

The outbreak of war in September 1939 affected British fisheries immediately. Many first-class fishing vessels were required to take up duties with the armed forces, and of those that were able to continue fishing (mostly the older craft of the fishing fleets) the majority were based at ports on the western side of the country.

The strategic position of the North Sea, between countries occupied by the warring nations, necessitated severe restrictions being imposed upon its fisheries. Large areas were prohibited to fishermen, whilst in other areas fishing was allowed only between specified hours. On account of such restrictions and the danger of operating in almost all parts of the North Sea, there was a gradual transference of fishing vessels away from the North Sea ports. Consequently such fishing as was continued off the English east coast was carried out mostly by smaller craft in coastal waters.

After the cessation of hostilities in May 1945, there was a rapid expansion of the North Sea fisheries from their wartime level, so that over a period of five complete years an area, previously heavily overfished, was rested from the attention of a considerable fleet of English fishing vessels, although the North Sea fisheries of some countries were not reduced so drastically as were those of Great Britain.

During the war years the collection of detailed English fisheries statistics was not possible and unfortunately a proportion of those collected was lost as a result of enemy action. Therefore, in order to investigate the effect of the war on the fisheries of the North Sea, attention will be mainly confined to a comparison of those years immediately before and after the war for which complete statistics are available, i. e., 1938 and 1946. English vessels, of which the first-class steam trawlers landed 88 % of the entire English catch from the North Sea in 1938, did not fish in the northern part of the North Sea in 1946, so that comparisons between the two years can be confined to the catches of steam trawlers in the central and southern parts of the North Sea, i. e., between latitudes 51°N. and 57°30′N.

The available data are more extensive and complete for plaice than for any other species of fish so that it has been possible to analyse the changes in the stocks of plaice in greater detail than the changes in the stocks of other species. Accordingly this report is in two parts. Part I by A. R. Margetts deals with the English North Sea trawl fisheries as a whole and the changes in the stocks of some commercially important species of fish other than plaice. Part II by S. J. Holt is concerned with the English North Sea plaice fishery.

Part I. The War and its Effect upon the Total Stocks of Demersal Fish in the North Sea, with Special Reference to Cod, Haddock, Sole, Turbot, Whiting and Dab.

The History of the North Sea during the War.

We have seen that the war meant to the British fishing industry severe limitations of the fleets, and enforced restrictions of fishing within specified limits of space and time. These restrictions, imposed by the Naval authorities, were continually undergoing small changes, the general trend of which was to open more areas of the North Sea to the fishermen.

During the latter part of 1939 fishing was permitted only in certain areas to the westward of longitude 3°E., the most extensive of which were three regions, one around the Shetland Islands, another off the east coast of Scotland — including the Long Forties and Fladen ground — and a third off East Anglia

and the Humber estuary between the South Dogger and latitude 52°N.

At the end of 1939 a mine barrier was laid as a continuous wide belt extending between the Moray Firth and the Thames estuary, approximately parallel to the coast, and about 15 to 20 miles offshore at most points. This greatly reduced the areas in which fishing was permitted, but existing fishing areas to the eastward of the barrier were supplemented by an area connecting the Dogger and Forties regions.

In June 1940 all fishing in the North Sea was prohibited, except within the Shetlands area and near the Orkney Islands.

During late 1940 some areas within about fifteen miles of the east coast of Scotland were opened to fishing, followed in January 1941 by small areas off the Humber and coast of Northumberland. The fishing grounds within a few miles of the Yorkshire coast were opened in mid 1941, from which time, until mid 1943, no significant changes were made in the regions permitted for fishing.

After mid 1943 there was a gradual increase in the areas where fishing was permitted until by the end of 1944 most of the coastal waters north of latitude 53°23′N. inshore of the mine barrier were available to fishermen. A small region around Smith's Knoll was opened between mid 1943 and early 1945.

After the war had ended, in the summer of 1945, the Dogger Bank, Silver Pits region, Forties and Fladen ground were opened, but the whole of the southern North Sea south of latitude 53°30′ N., apart from a small coastal area just south of the Humber estuary, remained closed.

Figure 1, Chart 1, shows those areas of the North Sea in which British vessels were allowed to work in November 1945. It will be noted that parts of the southern North Sea (Region IV c) were then opened, so that the 1946 statistics for that region reflect the conditions of the stocks of fish in an area immediately after its being entirely closed to fishing for five and a half years.

In April 1946 (Figure 1, Chart 2) an area of the eastern North Sea, including the Little Fisher Bank and the Holmen ground, was opened, to be increased in size by July, by which time also the major part of the northern North Sea was open, and the area in the Southern Bight in which fishing was permitted had been increased. (Figure 1, Chart 3.)

By the end of 1946 almost all of the North Sea grounds frequented by British fishermen were open for fishing, the remaining closed areas being situated along the coast of the Continent. (Figure 1, Chart 4.)

The Effects of the War on the Catches and Stocks of Fish in the North Sea.

1. Total Catches of Demersal Fish.

(a) Landings During the War Years.

The immediate consequence of the outbreak of war on the English North Sea fisheries was a great decrease in the catches of fish. The total catch of demersal fish landed by English first-class vessels of all types from anywhere in the North Sea was, in 1940, 19 %, and in 1941 only 14·5 % of that in 1938. Thereafter it gradually increased, year by year, until in 1944 it had reached 52 % of the 1938 catch.

Such increases in total landings of fish from the North Sea as were made during the course of the war (Table 1) were correlated directly with increases from year to year in the number of landings made by trawlers, the number of hours fishing by first-class vessels using all types of gear and the extent of areas in which fishing was permitted. The fishing grounds open at the time were in some districts more fully exploited than previously and restrictions limiting the time for fishing to certain hours of the day, which were applied to some regions in the early years of the war, were lifted in the later years. It is also reasonable to assume that the increase of stocks of fish in the North Sea during the war years which, as will be shown later, occurred to a very marked extent, had an increasingly beneficial effect on the catches of those vessels fishing during the war years.

Table 1. Landings of Demersal Fish from the North Sea by English 1st-Class Fishing Vessels.

	Total Landings in cwt.	% of 1938 Total	Total Hours Fishing
1938	1,482,190	—	—
1940	279,531	19 %	—
1941	215,035	14·5 %	47,241
1942	349,951	24 %	59,526
1943	523,007	35 %	99,856
1944	768,522	52 %	185,484

(b) Pre-war and Post-war Landings.

In 1938 English first-class steam trawlers working in the North Sea caught 1,325,285 cwt. of demersal fish, a total achieved as the result of 1,261,843 hours fishing. In 1946 the North Sea fleet of English steam trawlers, including a greater proportion of older vessels than in the 1938 fleet, spent 656,617 hours fishing, which represents almost exactly half of the effort of 1938, and yet caught more fish, their total landings for the year being 1,876,360 cwt., or about 140 % of the 1938 catch.

The weight of catch per 100 hours fishing is a useful index by which the relative abundance of fish in the sea can be compared. It can be shown that, with fishing intensities of the order of magnitude that were maintained over the periods and in the areas considered, this index is very nearly proportional to the mean density of the fishable stocks. When used to compare the two years 1938 and 1946, figures for this estimate of density of the stocks have been calculated for the sea areas which were fished in both years, and so are more strictly comparable than would be figures for the entire North Sea which was not available to fishermen in 1946. The weight

Table 2. **Total Demersal Fish.**

Catches by Steam Trawler from Areas of Central and Southern North Sea fished in 1946.

Total Catch, in cwt.

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1938	60,836	58,319	72,134	58,273	43,261	53,644	87,754	101,966	101,293	84,614	86,174	79,538	887,806
1946	135,714	118,225	197,529	162,945	171,606	100,747	222,409	203,393	180,403	170,519	107,807	105,063	1,876,360

Catch per 100 hours fishing, in cwt.

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1938	77	74	92	79	85	83	106	104	107	97	94	91	92
1946	308	314	356	255	248	262	283	291	336	291	235	256	286
Ratio 1946:1938	4·0	4·2	3·9	3·2	2·9	3·2	2·7	2·8	3·1	3·0	2·5	2·8	3·1

of fish to be caught on the grounds worked by steam trawlers in 1946 is shown to have increased more than threefold during the war years. (Table 2.)

The steady decline, from month to month through a year, in the ratio of the weight-density of stocks in 1946 to that in 1938 is attributable to the effect of the post-war fishing on the stocks.

After the 1914—1918 war GRAHAM (1) estimated that the maximum possible stock of the fish in the North Sea was of density 2·2 times as great as that in 1913. The catch per days absence of a trawler in 1913 (14·08 cwt.) must be corrected for the subsequent introduction of Vigneron Dahl gear before it can be compared with present day figures. Allowing for a 35 % increase in catches due to the use of this gear (2), the adapted figure for 1913 is 19 cwt. The 1938 catch per days absence was 14·04 cwt., so that the 1946 figure would be this multiplied by the observed density increase between 1938 and 1946 of 3·1, i. e., 43·5 cwt. If, in 1946, the stocks were at a maximum, their density would be $43{\cdot}5 \div 19 = 2{\cdot}3$ times the density in 1913, which is in very close agreement with GRAHAM's factor. However, the catches of Grimsby trawlers immediately after the war and the noticeable decline in the weight-density ratios referred to above indicate that the average stock density in 1946 was below the maximum.

(c) Catches of Grimsby Trawlers.

Grimsby is the premier North Sea fishing port of England and is so situated that trawlers based there can range economically over the greater part of the central and southern North Sea. The average of the catches landed at the end of trips by Grimsby North Sea trawlers is therefore to be regarded as a good quantitative sample of the stock of fish on the grounds. The number of trawlers working from the port over the period of investigation was never small, so that such errors as would be introduced into calculations by, for instance, mechanical breakdowns at sea, are minimized, particularly as the landings are considered by months. The duration of a voyage has been standardized as eight days, which is a fair average for these trawlers.

Statistics relating to the catches per trip are available from immediately after the war and show that the stocks of demersal fish were, in mid 1945, considerably greater than at the beginning of 1946 (Table 3, Fig. 2). In the few months immediately after the war the number of trawlers operating from Grimsby increased rapidly to a more constant number at the end of 1946, which, however, was less than that of 1938. In months when the ships were lying idle on account of strikes within the industry, the number at the port has been omitted from the table. (Table 4.)

Despite the increases in the extent of the grounds which could be fished, there was a rapid decline in the catch per trip in 1945, and this continued, to a less marked degree, throughout 1946, although in the autumn of 1946, with the opening of the prolific eastern area including the Little Fisher Bank and the Holmen ground to which many trawlers made voyages, a temporary increase in catches was noticeable. Spring and autumn maxima in the catches were common to both years. The catch per trip of Grimsby trawlers in 1946 had increased almost threefold since 1938, which indicates a rise in the level of fish stocks in the North Sea by a similar proportion to that shown by the catch per 100-hours index for all North Sea ports.

(d) The Eastern North Sea Fisheries.

The eastern part of the North Sea was closed to British trawlers for the duration of the war, and

Table 3. **Average Catch (in cwt.) per 8-day trip of Grimsby North Sea Trawler.**

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1938	72	76	94	94	90	83	99	100	108	99	96	85
1945.....	—	—	—	—	—	553	540	444	429	383	317	235
1946.....	227	231	297	273	257	228	267	270	341	247	157	158

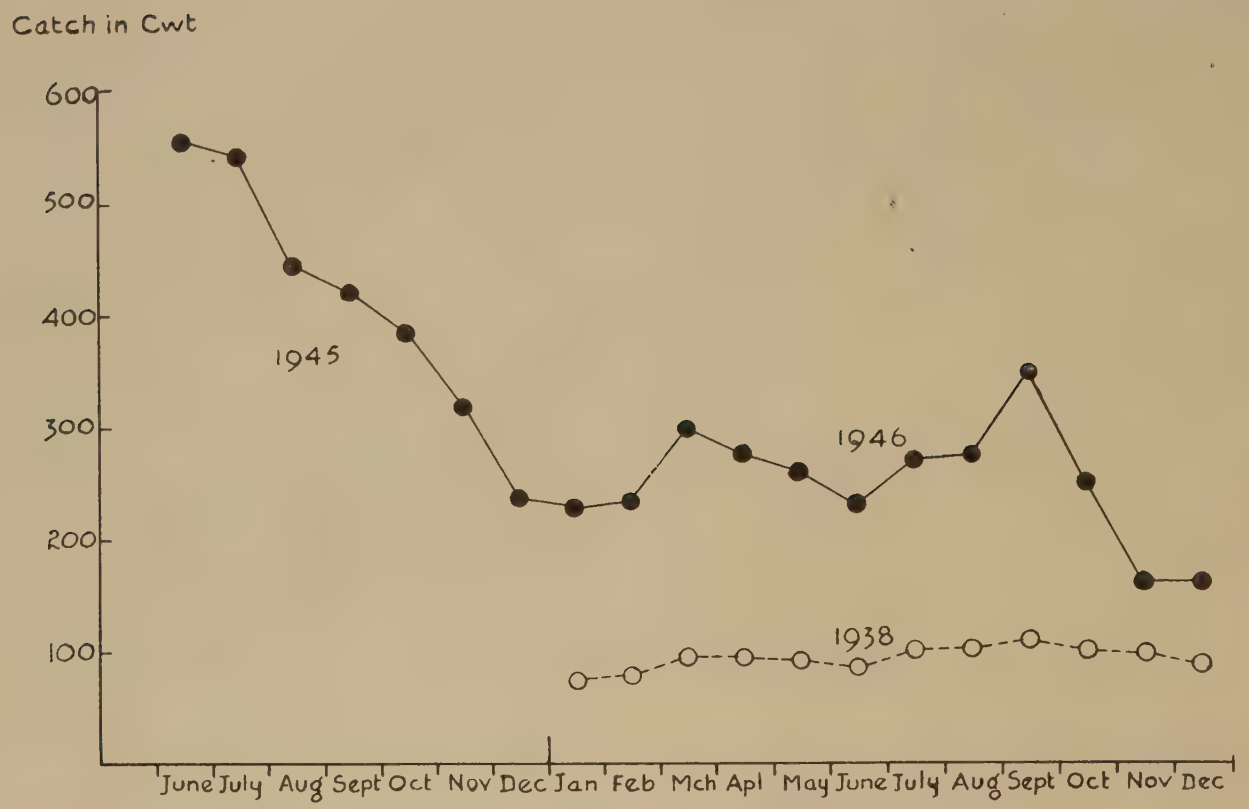


Figure 2. Weight of catch for an average eight-day trip of Grimsby first-class North Sea trawlers.

not until April 1946 was a comparatively small area of it, off the north-west coast of Denmark and embracing the Holmen ground and Little Fisher Bank, opened. The fishing on these grounds is seasonal, reaching its height in summer and autumn, when the catches of fish are composed almost entirely of cod and haddock of which, in weight, the latter species makes up rather more than half of the average catch. There is, therefore, good opportunity to study a fishery within the North Sea which had not been exploited by English trawlers for seven years, following a time when it had been very much over-exploited. Some fishing vessels from other European countries probably worked in the area during those years.

The activity of English trawlers in the eastern North Sea area bounded by latitudes 56°30′ N. and 57°30′ N. and longitudes 6° E. and 8° E. was rather different in the pre-war and post-war years under consideration. In 1938 the time spent there was very short throughout the winter and spring months but began to increase steadily from May onwards to reach a maximum in the months of August and September, thereafter declining rapidly. In 1946 the season was much shorter and the fishing more intense, for although the area was opened in April it was not until August that trawlers spent any appreciable time fishing there. In September trawlers spent about 50 % more time on the eastern grounds than they did in 1938, but the season was drawn to a close almost as rapidly as it had been opened and after October no vessel visited the area. However, in the short 1946 season with its more concentrated effort, the weight of fish taken from the area was considerably greater than during the more prolonged 1938 season and the catches per unit of time, of similar composition in the two years as regards species, were three and a half times greater after the war than before it. (Table 5.)

Table 4. Number of North Sea Trawlers working from Grimsby.

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average for Year
1938.....	—	—	—	—	—	—	—	—	—	—	—	—	221
1945.....	—	—	—	—	—	92	102	—	118	125	—	122	112
1946.....	126	136	142	129	132	—	146	159	165	167	163	160	148

Table 5. Eastern North Sea.

Area bounded by Latitudes 56°30′ N. and 57°30′ N. and Longitudes 6° E. and 8° E.

Total Catch of Demersal Fish by English Steam Trawlers, in cwt.

	May	June	July	Aug.	Sept.	Oct.	Period May–Oct.
1938	1,318	3,805	6,404	12,449	13,385	6,436	43,797
1946	433	659	922	15,640	70,246	18,036	105,936

Total hours fishing by English Steam Trawlers.

	May	June	July	Aug.	Sept.	Oct.	Period May–Oct.
1938	977	3,075	4,566	9,238	9,321	4,117	31,294
1946	120	108	84	2,421	13,790	4,623	21,146

Catch per 100 hours fishing, in cwt.

	May	June	July	Aug.	Sept.	Oct.	Period May–Oct.
1938	135	124	140	135	144	156	140
1946	361	610	1,098	646	509	390	501
Ratio 1946: 1938	2·7	4·9	7·8	4·8	3·5	2·5	3·6

2. Catches of the Various Principal Species.

It might reasonably be expected that the quantitative relationship between fishes of different species within a habitat such as the North Sea might be disturbed by such a great decrease in the mortality due to fishing as took place during the war. Sufficient data are not at present available for accurate calculations to be made of actual numbers of individuals of species other than the plaice, but the proportions of various species in the total catches of demersal fish by weight can be calculated. For this purpose the catches from two separate areas, both heavily fished immediately before and after the war, namely the Silver Pits and Smith's Knoll areas, have been investigated. (Table 6.)

On account of the differences in growth-rate between different species of fish the proportion by weight may not have varied in the same way as the proportion by actual numbers over the period when the stocks of fish in the area were increasing. The increases in the proportion of cod and haddock in catches from the Silver Pits area may be due to this. There appears to have been relatively less whiting and relatively more soles in the catches after the war, and these changes are of particular interest. In general, however, no marked changes have occurred in the relative quantities of other species caught.

In the following brief comparison of the stocks of fish of certain species in the North Sea in pre-war and post-war years it is necessary to take account of the restrictions which in 1946 denied to the fishermen the use of some grounds which were known to be prolific in certain species of fish. Therefore, to ensure just comparisons unaffected by the uneven distribution of the fish and fishing effort, only those regions of the North Sea in which the particular species was caught in 1946 have been compared.

(a) Cod.

The catches of cod from the central and southern North Sea in 1946 were very much greater than in 1938. (Table 7.)

Over the whole year of 1946 the density of cod in the North Sea south of latitude 56°30′ N., as shown by the catch per 100 hours fishing by the English steam trawlers, increased about three and a half times during the war, which increase is very closely of the same order as that of the cod and haddock combined in the eastern North Sea. The seasonal fluctuations in catches of cod were similar in 1938 and 1946.

In the area off the Yorkshire coast bounded by the meridians 0° and 2° E. and the parallels 53°30′ N. and 55° N., which includes the chief spawning grounds of the North Sea cod, the increase in density by weight of that fish during the war was greater than for the wider area of the North Sea, due probably to the concentration of a greater proportion of larger mature fish in 1946 than in 1938. (Table 8.) Unfortunately, no length measurements of cod from this area were made.

By dividing the area of the central and southern North Sea into statistical rectangles and making comparisons of the catch of cod per 100 hours fishing in each rectangle by months, it is possible to make, over a whole year, 417 comparisons, all but thirteen of which show the weight-density of cod to have increased. Of these exceptions the majority are widely scattered in space and time or concern rectangles which were only lightly fished in one or both years and therefore inadequately sampled. These exceptions, then, may be regarded as insignificant. In December 1946 the density of cod in the narrow area between

Table 6. Proportions of various Species in Catches of Steam Trawlers in Silver Pits and Smith's Knoll Areas.

Silver Pits Species	1938 Total Catch in cwt.	1938 % of Total Demersal	1946 Total Catch in cwt.	1946 % of Total Demersal
Total Demersal .	56,004		117,503	
Plaice.....	18,893	34 %	36,366	31 %
Cod	15,602	28 %	41,224	35 %
Haddock.....	2,994	5 %	10,434	9 %
Whiting.....	8,795	16 %	8,200	7 %
Turbot.....	3,020	5 %	7,227	6 %
Sole	1,141	2 %	4,702	4 %

Smith's Knoll Species	1938 Total Catch in cwt.	1938 % of Total Demersal	1946 Total Catch in cwt.	1946 % of Total Demersal
Total Demersal .	52,835		122,319	
Plaice.....	28,084	53 %	58,877	47 %
Cod	6,067	11 %	17,090	14 %
Haddock.....	72	0·1 %	1,090	0·9 %
Whiting.....	4,155	8 %	5,666	5 %
Turbot.....	2,393	4 %	5,081	4 %
Sole	4,952	9 %	16,106	13 %

Table 7. **Cod.**

Catches by Steam Trawlers from Central and Southern North Sea.

Total Catch, in cwt.

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1938	17,623	18,902	39,019	28,030	13,818	15,286	23,876	30,852	27,633	26,399	23,591	17,960	282,989
1946	28,776	48,214	100,113	59,364	61,256	35,340	87,192	80,368	47,856	55,500	32,496	26,033	662,508

Catch per 100 hours fishing, in cwt.

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1938	18	22	42	37	27	22	28	31	32	30	26	22	28
1946	66	128	182	96	93	93	112	120	122	106	72	65	106
Ratio 1946:1938	3·7	5·8	4·3	2·6	3·4	4·2	4·0	3·9	3·8	3·5	2·8	3·0	3·8

Flamborough Head and the Dogger Bank was less than in the same month of 1938, and in the area eastward of Smith's Knoll it was less in October. Both of these areas were well sampled by the trawlers in both years, but, as these reduced densities were not apparent for longer than a month, they can be attributed to slightly different movements of this highly migratory fish in the two years under consideration.

Comparable measurements of cod in 1938 and 1946 were confined to the west and north-west Dogger and Firth of Forth regions between latitudes 54°30′ N. and 56°30′ N. and to the first three quarters of the year. The samples in 1938 were of small numbers taken at sea while those in 1946 were of larger numbers measured at the port of landing. In neither year was the sampling of the area very thorough, but was sufficient to show the change during the war from a population of predominantly small fish, of length 40—50 cm., to one in which the proportion of large fish, of length 80—95 cm., was very much greater. The greater proportion of larger mature fish after the war is illustrated by the measurements made in the first quarter of each year, as the area sampled includes some cod spawning grounds to which the mature fish move in the early part of the year. (Table 9, Fig. 3.)

(b) Haddock.

The weight-density of haddock in the regions of the North Sea where this fish was caught by English trawlers in 1946 increased during the war years but not quite so markedly as did that of cod. (Table 10.)

By treating the statistics in the same way as for the cod, 342 comparisons can be made of the catch per 100 hours fishing in regions by months, and of these only twenty-four show a decrease during the war years, the rest increases. Again, as with cod, the majority of the exceptions are insignificant on account of incomplete sampling, or are in areas which lie outside the main haddock grounds, while a very few may be attributed to slight differences in the timing of the movements of the fish.

(c) Sole.

This species has, by virtue of its high market value, always been much sought after by the English North Sea trawlermen, so that stocks were very low when war broke out. The principal sole grounds in the southern North Sea were completely closed during the war, and it is reasonable to assume that the very considerable increase in density by weight of this fish, in the area from which the vast majority were taken in 1946 (Table 11), was directly attributable

Table 8. **Cod.**

Catches by Steam Trawlers from Area bounded by Latitudes 53°30′ N. and 55° N. and Longitudes 0° and 2° E.

Total Catch, in cwt.

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1938	1,274	4,662	16,187	8,246	1,864	3,320	4,928	7,127	7,194	6,975	3,499	2,068	67,344
1946	3,233	21,963	65,764	24,676	24,930	6,892	23,917	20,949	14,277	14,974	6,593	2,649	230,817

Catch per 100 hours fishing, in cwt.

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1938	11	26	52	34	13	16	23	27	30	34	36	43	30
1946	122	293	348	151	121	122	167	154	176	128	92	94	178
Ratio 1946:1938	11·1	11·3	6·7	4·4	9·3	7·3	7·2	5·7	5·9	3·8	2·6	2·2	5·9

6.

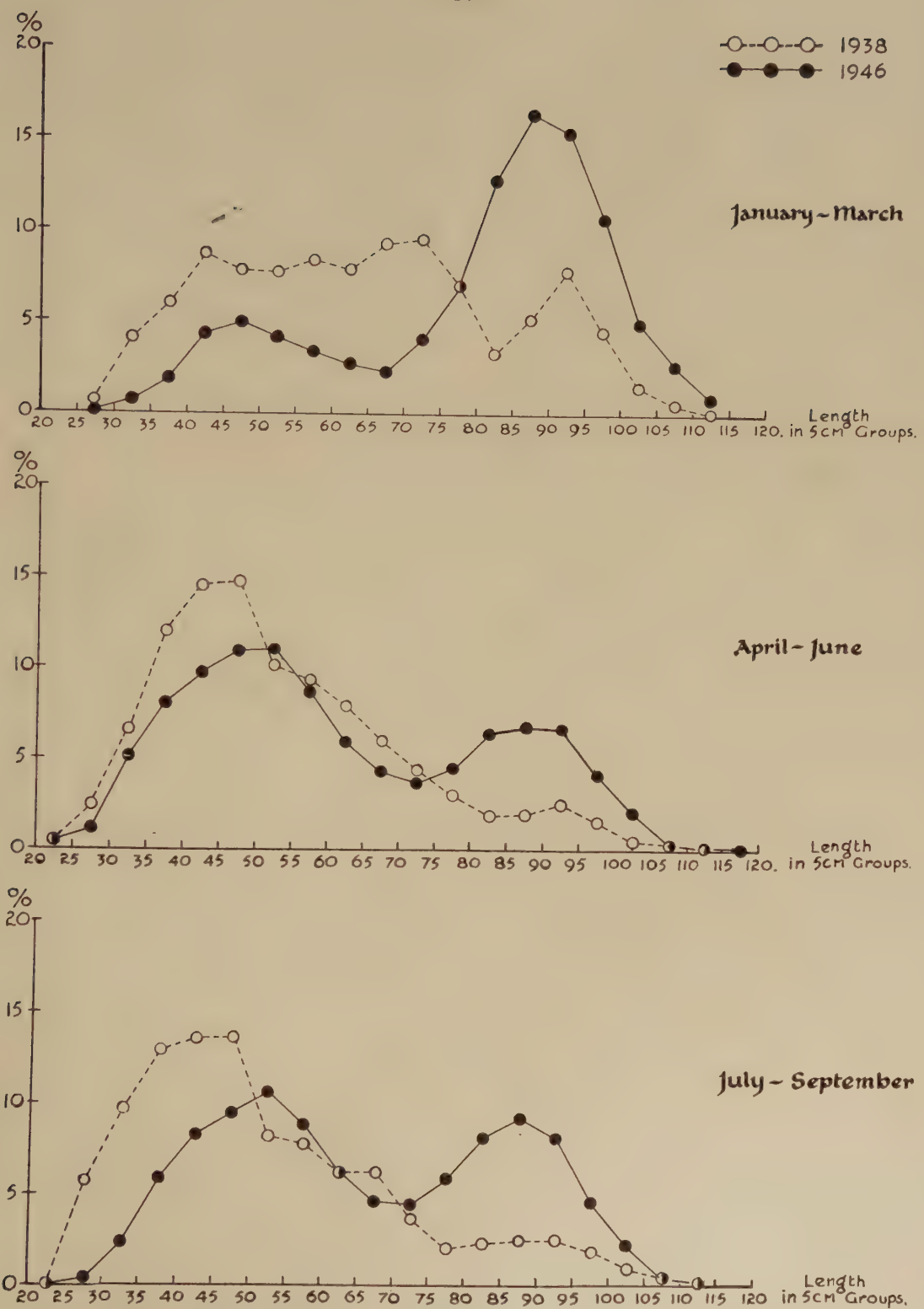


Figure 3. Percentage length distribution, in 5-cm. groups, of Cod from area between West Dogger and Firth of Forth in quarters of 1938 and 1946.

Table 9. Cod.

Percentage Length Distribution in NW. Dogger and Firth of Forth Area.

Length in cm.	Jan.–March 1938	Jan.–March 1946	April–June 1938	April–June 1946	July–Sept. 1938	July–Sept. 1946
20—24....	—	—	0·4	0·1	0·1	—
25—29....	0·6	0·1	2·4	1·1	5·7	0·4
30—34....	4·1	0·7	6·6	5·1	9·7	2·4
35—39....	6·0	1·9	12·0	8·1	12·9	5·9
40—44....	8·7	4·4	14·5	9·7	13·5	8·3
45—49....	7·8	5·0	14·7	10·9	13·6	9·5
50—54....	7·7	4·2	10·1	11·0	8·1	10·6
55—59....	8·4	3·4	9·3	8·7	7·7	8·8
60—64....	7·9	2·7	7·9	5·9	6·3	6·2
65—69....	9·3	2·3	6·0	4·3	6·2	4·6
70—74....	9·6	4·1	4·4	3·7	3·6	4·4
75—79....	7·0	6·9	3·0	4·5	2·0	5·9
80—84....	3·3	12·9	1·9	6·4	2·3	8·1
85—89....	5·2	16·5	1·9	6·8	2·5	9·2
90—94....	7·8	15·5	2·5	6·7	2·5	8·1
95—99....	4·5	10·8	1·5	4·1	1·9	4·6
100—104...	1·5	5·0	0·5	2·0	0·9	2·2
105—109...	0·5	2·7	0·3	0·7	0·4	0·6
110—114...	0·1	0·9	0·1	0·1	0·1	0·2
115—119...	—	—	—	0·1	—	—

to the protection from fishing afforded by the closure of these grounds. This increase in density is greater than for any other species investigated, and it has already been shown that the proportion by weight of soles in catches of demersal fish in the southern North Sea increased by about 50 % during the war. The gradual decline throughout 1946 in the ratio of the density of soles in 1946 to that in 1938, on one of the principal sole grounds around Smith's Knoll, is almost certainly due to the unusually intense fishing of the area in that year rapidly thinning out the stocks. For seven months of the year, despite reductions in the size of the fleet of trawlers, the time spent fishing in the Smith's Knoll area in 1946 was greater than in 1938. (Table 12.)

Of 237 comparisons of density by weight of soles by rectangles and months in 1938 and 1946, all but sixteen show increases. The exceptions were confined to the months between April and October, and almost all of them to the area off the Yorkshire coast and Humber estuary to the south west of the Dogger, indicating either a summer seasonal abundance in that area in 1938 or scarcity in 1946.

(d) Turbot.

The density by weight of the stocks of turbot in the North Sea increased during the war in the same ratio as did that of the total demersal fish. (Table 13.) Detailed monthly comparisons of small areas indicate this increase to be common to all regions where the turbot is found in the central and southern North Sea, the fifteen of 423 possible comparisons made, which show slight decreases in density of this species on any ground at a particular time, being mostly insignificant and showing no major changes in the distribution of the species.

(e) Whiting.

The stocks of whiting in the North Sea did not increase in the same way, or to the same extent, as did those of other commercially important species.

Total catches by English steam trawlers in 1946 were not so great as in 1938, and, considering complete years, the weight-density was only very slightly greater after than immediately before the war. In the summer months the density was less in 1946 than in 1938 and only in April, when catches of whiting are normally near the minimum for any month of the year, did the weight-density show an increase of the same order as that of other fish between the pre-war and post-war years. (Table 14.)

In comparing rectangles by months in 1938 and 1946 a total of 354 comparisons can be made of which 126 show decreases in the catch per 100 hours fishing, the majority of these falling in February and the period July to December inclusive. In August more than two thirds of the possible comparisons of areas within the North Sea show decreases in the density of whiting between 1938 and 1946. Consideration of 1937 statistics reveals that catches in 1938 were greater than in the previous year, particularly in July and August, and also that the density

Table 10. Haddock.

Catches by Steam Trawlers from Central and Southern North Sea.

Total Catch, in cwt.

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1938	5,685	2,554	763	1,328	4,108	9,207	16,654	21,808	20,292	15,778	12,680	5,331	116,188
1946	13,426	3,950	1,410	4,967	14,507	9,616	23,550	29,839	19,668	26,615	20,426	21,652	189,626

Catch per 100 hours fishing, in cwt.

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1938	8	3	1	2	8	14	20	22	24	18	15	7	12
1946	38	14	3	9	28	27	31	46	53	57	63	60	34
Ratio 1946:1938	4·7	4·7	3·0	4·5	3·5	1·9	1·6	2·1	2·2	3·2	4·2	8·6	2·8

Table 11. **Sole.**

Catches by Steam Trawlers from Central and Southern North Sea.

Total catch, in cwt.

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1938	4,630	2,375	2,037	1,383	405	290	653	917	1,251	1,989	2,852	2,897	21,679
1946	17,264	11,261	8,090	4,831	4,511	2,350	4,204	2,896	3,254	3,399	4,099	5,872	72,031

Catch per 100 hours fishing, in cwt.

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1938	6	3	3	2	1	0	1	1	2	3	4	4	3
1946	44	32	15	8	8	8	6	6	14	8	11	20	14
Ratio 1946:1938	7·3	10·7	5·0	4·0	8·0	—	6·0	6·0	7·0	2·7	2·8	5·0	4·7

Table 12. **Sole.**

Catches by Steam Trawlers from Smith's Knoll Area.

Total Catch, in cwt.

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1938	784	315	106	91	6	13	107	129	212	748	1,103	1,338	4,952
1946	3,094	1,984	1,614	353	258	1,017	2,018	1,292	1,711	594	655	1,516	16,106

Catch per 100 hours fishing, in cwt.

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1938	7	4	4	3	1	2	3	3	5	7	7	7	6
1946	73	44	32	12	9	11	14	13	28	14	16	25	22
Ratio 1946:1938	10·4	11·0	8·0	4·0	9·0	5·5	4·7	4·3	5·6	2·0	2·3	3·6	3·7

by weight was, in those two months of 1938, more than double that for the corresponding months of 1937 and remained considerably greater in 1938 than in 1937 for the rest of the year. However, a comparison of the monthly catch per 100 hours fishing in 1937 and 1946, while showing the general increase to be greater than between 1938 and 1946, indicates a definite thinning out of the stocks in the summer months, with the fish less dense in August 1946 than in the same month of 1937.

It therefore appears that, whereas there was probably an unusually great abundance of whiting in the summer and autumn months of 1938, there was an unusual deficiency in 1946. In view of the fact that over a whole year the catches of trawlers show an increase in the density by weight of this fish to have occurred during the war years, it may well be that the seasonal movements of the whiting were very different in 1937, 1938 and 1946, with 1938 being a year in which whiting of marketable size were particularly abundant. Assuming that the stocks of this fish were not reduced to the pre-war level by the fishing in the early months of 1946, which assumption is supported by the increase in the ratio

Table 13. **Turbot.**

Catches by Steam Trawlers from Central and Southern North Sea.

Total Catch, in cwt.

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1938	2,534	1,567	2,008	1,613	1,387	2,305	2,318	2,918	3,096	2,604	2,417	2,371	27,138
1946	4,781	2,965	5,055	5,479	7,306	3,665	6,975	8,144	3,660	7,068	4,846	3,350	63,294

Catch per 100 hours fishing, in cwt.

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1938	3	2	2	2	4	4	3	4	4	4	3	3	3
1946	12	8	9	9	11	11	10	14	10	15	12	10	11
Ratio 1946:1938	4·0	4·0	4·5	4·5	2·8	2·8	3·3	3·5	2·5	3·8	4·0	3·3	3·7

Table 14. **Whiting.**

Catches by Steam Trawlers from Central and Southern North Sea.

Total Catch, in cwt.

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1937	5,720	6,087	5,924	4,009	2,970	6,716	10,143	11,332	11,280	8,814	9,290	9,846	92,131
1938	9,986	7,783	6,280	3,440	2,417	5,994	15,940	18,843	12,035	9,133	10,922	12,418	114,791
1946	8,281	4,111	7,961	8,041	7,152	5,953	9,863	5,191	4,229	7,051	7,592	12,575	88,000

Catch per 100 hours fishing, in cwt.

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1937	6	7	9	5	4	7	8	9	9	7	8	10	8
1938	11	9	7	4	5	9	19	19	14	11	12	15	12
1946	19	11	15	13	11	16	13	8	11	14	17	39	14
Ratio													
1946:1938	1·7	1·2	2·1	3·2	2·2	1·8	0·7	0·4	0·8	1·3	1·4	2·6	1·2
1946:1937	3·2	1·6	1·7	2·6	2·8	2·3	1·6	0·9	1·2	2·0	2·1	3·9	1·75
1938:1937	1·8	1·2	0·8	0·8	1·2	1·3	2·4	2·1	1·6	1·6	1·5	1·5	1·5

of density by weight 1946:1938 over most of the central and southern North Sea towards the end of the year, and by the comparatively low ratio of these densities between 1938 and 1946 for the month of February, the question of the whereabouts of a large proportion of the stock of whiting during the summer of 1946, when not being fished by English trawlers, remains unexplained. Over the whole years of 1938 and 1946 the regions of the North Sea from which whiting were taken in greatest quantities were very closely similar.

Small whiting form a large proportion of the food of some other fishes, so that the relatively small increase in the stock of whiting, which took place when the stocks of other demersal fish were increasing considerably, may possibly be due to some of the other species increasing in numbers to a certain extent at the expense of this species.

(f) Dab.

The weight-density of the dab stock in the North Sea around and south of the Dogger Bank, in those months of 1946 for which statistics are available, appears to have remained unchanged from that over the comparable period of 1938. (Table 15.) The ratios of weight-densities 1946:1938 in the later months of the year are noticeably larger than in the earlier months. The failure of the stock of dabs to increase during the war years by anything approaching the same extent as did the stocks of total demersal fish is perhaps attributable to reasons similar to those suggested in the case of the whiting.

Conclusions of Part I.

1) There has been a general increase in the weight-density of demersal fish in the central and southern North Sea during the war years. Comparison of the catch per unit time for the years 1938 and 1946, in those areas of the North Sea fished by English trawlers in 1946, shows the weight-density of total stocks of demersal fish to have increased rather more than threefold during the war. (Table 2.) Statistics relating to the port of Grimsby for 1945 indicate that the wartime increase was probably more than fourfold and that the post-war trawling soon began to appreciably diminish the stocks. (Table 3.) The similar ratio of weight-density, 1946:1938, of certain species

Table 15. **Dab.**

Catches by Steam Trawlers from Central and Southern North Sea.

Total Catch, in cwt.

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1938	—	—	—	1,644	1,489	1,996	1,923	2,456	2,548	2,138	1,763	1,458	17,415
1946	—	—	—	1,095	1,378	585	2,042	1,898	950	2,300	1,893	923	13,064

Catch per 100 hours fishing, in cwt.

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1938	—	—	—	2·5	3·9	3·5	2·7	3·1	3·6	3·0	2·4	2·1	2·9
1946	—	—	—	1·9	2·3	1·7	2·8	3·2	2·7	5·0	4·8	2·9	3·0
Ratio													
1946:1938	—	—	—	0·8	0·6	0·5	1·0	1·0	0·75	1·7	2·0	1·4	1·0

was for cod 3·8 (Table 7), haddock 2·8 (Table 10), sole 4·7 (Table 11), turbot 3·7 (Table 13), whiting 1·2 (Table 14), and dab 1·0 (Table 15). It is suggested that some other species may have increased in density to a certain extent at the expense of the whiting and dab.

2) The magnitude of the increase in stock density is not incompatible with the estimate of the maximum possible North Sea stock density made by GRAHAM, although this is probably an underestimate as there is evidence to suggest that in 1946 the stock density was not at its maximum. (Section 1(b).)

3) The replenishing of the stocks of demersal fish in the North Sea, which has been shown to have occurred by 1945 and 1946, was directly attributable to the discontinuation of fishing in the major part of the North Sea between 1940 and mid 1945. The recommencement of fishing in any particular area after the war marked the beginning of a decline in the density by weight of fish in that area. (Tables 3 and 4.)

4) The general composition of the catches of English trawlers after the war appears to have been little changed since 1938, except that there has been a relatively large increase in the proportion of soles in landings from more southerly parts of the North Sea, and a decrease in the proportion of whiting in landings from the principal fishing grounds. (Table 6.)

5) Cod measurements show a greater proportion of larger fish in the post-war period. (Table 9.)

Part II. The Effect of the War on the English Plaice Fishery and Population of the Southern North Sea.

The following is a preliminary analysis and comparison of the English statistics relating to the southern North Sea plaice fishery in 1938 and 1946, the latter being the first year following the war for which complete records are available.

Collection of Data.

Ichthyometric work was discontinued in March 1939, and restarted in the autumn of 1945.

In many ways pre- and post-war data are not strictly comparable, for since the war plaice have no longer been sorted into size categories on the market. Efficient sampling was thus considerably easier in 1946 than in 1938, when the catches were divided into six market categories, samples of which were taken at Lowestoft and Grimsby once in each quarter of the year. Otoliths for age-determination, and length and weight measurements, were also obtained, but it is not known from which fishing grounds these samples originated. It has, therefore, been necessary to make slight adjustments to the pre-war data in order to make adequate comparisons. From November 1945 onwards, length measurements of the landings have been made almost every day, and otolith samples have been taken once a month at both ports, thus sampling the fishery fairly adequately.

It is most important to note that it is the *fishery*, and not the fishable plaice population which is studied by this method, and any transference of conclusions to the population must be made with care.

The Fishing Effort compared.

The proportion of the different types of vessels in the east coast fishing fleet (Table 18) and the mean tonnage of English 1st-class steam trawlers have not undergone any marked change, so that it is justifiable to take the "hours fishing" ratios given in Tables 16 and 17 as indices of the comparative fishing rates. (3.)

There does not appear to be any significant regression during the year in the ratios of hours fishing in 1946 to those in 1938 quoted in Tables 16 and 17, which shows that in 1946 we are not dealing with an expanding fishery. It is significant therefore, that if the June ratio in Table 16 is excluded, there is an apparent change in the season of the fishing effort, the available power being more concentrated into the summer months after the war. (Figure 4.) The clue to the understanding of this change is given in the last two columns of Table 16, shown graphically in Figure 5, where it is seen that in both 1938 and 1946 Lowestoft took a relatively greater part in the

Table 16. Total Hours Fishing in Region IV b and c by 1st-Class English Steam Trawlers.

Year / Month	1946	1938	1946 / 1938	Hours fishing Grimsby / Lowestoft 1946	1938
Jan.	44,093	122,770	0·36	2·35	3·31
Feb.	37,592	101,364	0·37	1·96	3·93
March	55,519	108,327	0·51	2·03	7·09
April	63,912	84,765	0·75	2·16	8·17
May	69,235	72,830	0·95	2·05	11·78
June	38,445	90,486	(0·42)	(0·92)	8·98
July	78,627	95,659	0·82	2·13	9·91
Aug.	69,918	114,472	0·61	1·96	9·70
Sept.	53,761	106,980	0·50	2·17	7·87
Oct.	58,568	104,038	0·56	2·20	8·15
Nov.	45,964	98,463	0·47	2·36	6·79
Dec.	40,983	95,117	0·43	2·71	4·76
Year	656,617	1,195,271	0·55	2·05	6·38

(*Note:*—The low ratio for June in the fourth and fifth columns are caused by a fishermen's strike. Had this strike not occurred, the June 1946/1938 ratio would probably have been about 0.60.)

Table 17. Ratios of Hours Fishing 1946/1938 by English 1st-Class Steam Trawlers in Region IV c.

Rectangle / Month	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
E 5	—	0·6	—	0·1	0·1	0·9	—	—	—	—	0·2	0·1	0·1
F 1	·02	0·1	0·1	9·4	1·1	1·2	2·8	2·8	4·4	1·3	0·6	0·2	0·3
F 3	—	—	—	—	—	—	—	—	—	—	—	—	0·1
F 4	—	—	0·2	—	—	—	—	—	—	—	—	—	0·5
F 5	0·1	0·1	0·1	0·9	2·8	0·4	1·5	0·8	0·6	0·9	0·7	0·5	0·7
G 2	0·04	0·1	0·1	0·03	—	—	1·7	—	—	—	0·01	0·05	0·1
G 3	6·2	1·2	2·2	0·8	—	5·7	—	—	6·4	19·1	2·6	1·2	2·2
G 4	0·4	0·6	1·7	1·0	6·7	14·4	3·9	2·6	1·6	0·4	0·3	0·3	0·9
G 5	4·3	0·3	0·4	1·3	3·5	1·5	2·2	2·4	0·5	1·6	1·0	0·4	1·2
H 3	—	1·4	—	—	—	—	—	—	—	3·1	2·4	—	3·7
H 4	0·5	5·0	7·6	6·4	51·4	1·2	0·8	2·4	0·9	4·1	1·1	5·3	3·8
H 5	1·2	1·4	2·5	3·0	15·7	—	11·7	19·3	3·0	4·4	0·1	0·06	2·8
J 3	—	—	—	—	—	—	—	—	—	—	—	—	0·1
J 5	—	—	—	—	—	—	—	—	—	—	—	—	1·6

Table 18. Expenditure of Fishing Power of 1st-Class English Vessels in Southern North Sea (Regions IV b and c).

Year	No. of Voyages				Hours fishing				Total Hours Fishing	% Steam Trawl of Total	% Steam Trawl of Total Trawl	Ratio of Hours fishing 1946/1938
	Trawl		Seine		Trawl		Seine					
	Steam	Motor	Steam	Motor	Steam	Motor	Steam	Motor				
1938 ...	13,408	1,698	318	473	1,132,297	97,133	21,135	19,310	1,269,875	89	92	Steam Trawl 0·579
1941 ...	929	141	0	430	30,842	584	0	5,518	36,944	83	98	
1942 ...	728	2	75	601	31,794	60	1,110	8,650	41,614	76	100	Total Trawl and Seine 0·574
1943 ...	1,251	60	207	858	73,527	216	5,679	12,259	91,681	80	100	
1944 ...	2,647	2	190	450	166,172	4	7,531	9,406	183,113	91	100	
1945 ...	5,130	96	253	413	404,600	6,816	12,740	21,387	445,543	91	98	
1946 ...	7,705	707	309	652	656,617	31,092	18,729	22,488	728,926	90	95	

Table 19. Plaice Landings at Lowestoft and Grimsby from Regions IV b and c, 1938 and 1946.

Table 19 a. Weight landed, in cwt.

Port / Year	1938	1946
Grimsby	185,082	312,914
Lowestoft	37,610	144,638
Total ...	222,590	457,552

Table 19 b. Monthly totals of numbers and weight landed and average weight of individual fish.

Month	Port of Landing / Year	1938			1946			Ratio of average weights 1938/1946
		Estimated No. in millions	Weight in 1,000 kilo	Average weight of fish in g.	Estimated No. in millions	Weight in 1,000 kilo	Average weight of fish in g.	
March	Grimsby	3·53	933·8	252	3·65	1,811·7	423	0·60
April	Lowestoft	0·60	106·4		2·43	762·6		
June	Grimsby	2·51	702·7	280	—	—	365	0·58
July	Lowestoft	0·64	136·5	213	2·55	930·4		
Sept.	Grimsby	2·44	827·2	320	1·11	898·3	605	0·53
Oct.	Lowestoft	0·60	142·8		1·04	407·1		
Dec.	Grimsby	2·52	853·1	331	0·90	652·1	636	0·52
Dec.	Lowestoft	0·50	146·0		0·57	283·9		

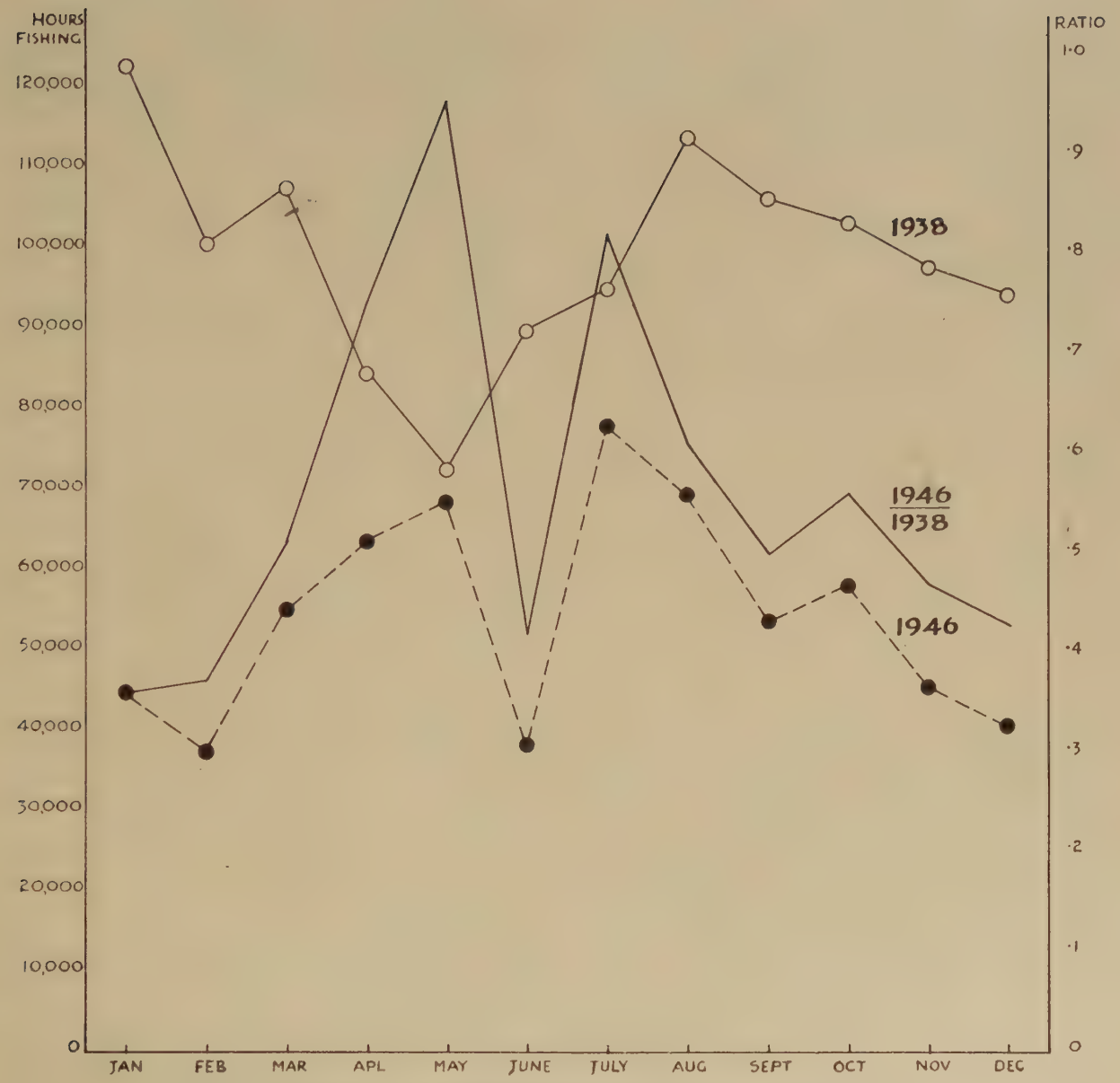


Figure 4. Hours fishing by first-class English steam trawlers in Regions IV b and c.

summer fishing. Lowestoft's contribution to the fishing effort is greater overall in 1946 than in 1938; these two facts account for the curves of Figure 4. It seems, however, that the geographical distribution of the fishing effort has changed in the way indicated in Figure 6, Chart I. When this distribution is compared with Figure 1 it is clear that this change is at least partly a result of the prohibition of fishing in many areas of the North Sea.

Another, and probably better, picture of the change in concentration of fishing is given in Figure 6, Chart II, showing by rectangles the ratios of the percentage distribution of the fishing effort by English 1st-class steam trawlers for 1946 and 1938. Although the correlation of low ratios with prohibited areas and high ratios with open areas is good, it is not complete — in particular rectangles C 13, D 13, E 13 and H 4 are anomalous.

The Catches compared.

1. The Gross Catch.

In 1946, the total catch of plaice from the North Sea landed at English ports by British trawlers was approximately double the 1938 figure of 242,119 cwt.

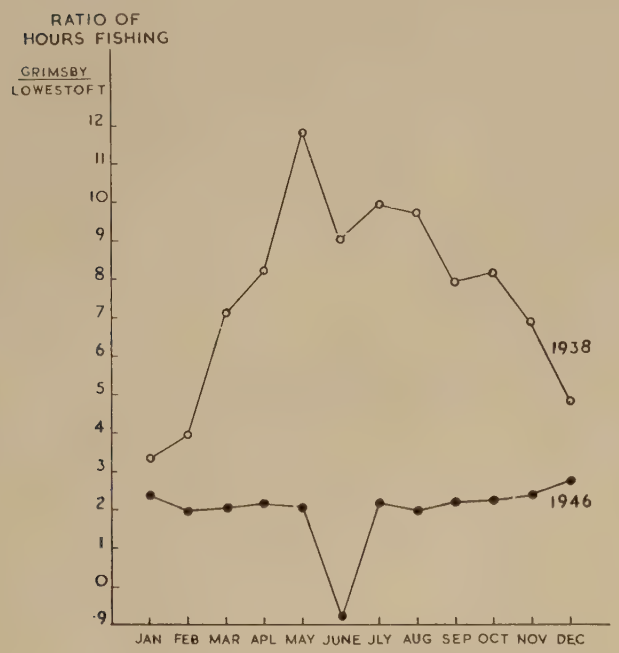


Figure 5. Hours fishing by first-class English steam trawlers in Regions IV b and c. Ratio $\frac{\text{Lowestoft}}{\text{Grimsby}}$ in 1938 and 1929.

Lowestoft has increased in relative importance as a port of landing of North Sea plaice. (Table 19.) Table 19b also shows that the greater weight of plaice landed in the post-war year is due to the higher average weight of the fish and not to any increase in the numbers caught.

Figure 7 shows the percentage by weight of plaice in the demersal landings for 1938 and 1946, and it will be seen that the changes in the thickly populated areas are relatively slight, with the exception of the coastal rectangles E 5 and F 3, although there have been large increases in many rectangles of region IV b.

The ratios of plaice landings in 1946 and 1938, rectangle by rectangle, regardless of the port of landing, are given in Figure 8.

2. The Composition of the Catch.

The weights of the lower age-groups in the otolith samples taken periodically at Lowestoft and Grimsby are slightly greater than before the war and the older fish are considerably lighter; particularly is this the case in the Lowestoft samples. If it is assumed that these samples are both representative of the fishery and of the plaice population, the graphs in Figure 9 show that the increase in average weight of fish in the landings cannot be accounted for by assuming a general increase of the growth-rate. The reason for the change in the mean weight is seen in a comparison of the age-group distributions of the samples (Figure 10) where it is apparent that the modal age-group of the plaice has increased from IV in 1938 to VII in 1946.

The weight/length relationships of the pre- and post-war samples have been investigated. As the changes found are "insignificant", the diagrams of the length distributions of the 1938 and 1946 catches show directly the alteration in size composition. (Figure 11.) Comparison of the 1945 curve with that of 1946 shows that by the end of the latter year the population had started to return towards its pre-war state.

The changes observed in the characters of the fishable population may be accounted for by assuming that fishing on the eastern, young-fish grounds, was more intense during than before the war, although it is known that the fishing effort decreased in the central area of the regions considered — that is those grounds fished principally by English trawlers operating from Lowestoft and Grimsby.

If this were so, as seems likely, it would be expected that a higher growth-rate caused by the decreased density of young fish, would result in the observed values of the mean weight of fish in the lower age-groups of the English catch being greater in 1946 than in 1938, as is the case. On the other hand, owing to the cessation of fishing on the older-fish grounds, and the lowered mortality rate, the numbers increased to such an extent that growth was retarded, resulting in the average weight of the fish in these higher age-groups being lower after the war than in 1938 and the preceding years.

The Relative Population Densities compared.

It can be shown that the catch per unit fishing gives an estimate of the density of the "fishable" population which lies somewhere between the true mean density over the period considered and the initial density. As both the number-density and weight-density declined during 1946, and as the catch in cwt. per 100 hours fishing by English 1st-class trawlers is used as the density index over periods of one month and one year, the values given for the density increase during the war period are underestimates.

When Charts I and II, Figure 12, giving the year's catch in cwt. per 100 hours fishing by 1st-class English steam trawlers for each rectangle in regions IV b and c, are compared with similar charts for 1925—1937 (4), it will be seen that in this respect 1938 is typical of the years immediately preceding the war, and that there has been an all round weight-density increase during the war years. (Figure 13.)

Table 20 shows the ratios of the post- and pre-war

Figure 6. Chart I. Ratio of hours fishing by first-class English steam trawlers $\frac{1946}{1938}$ in Regions IV b and c.

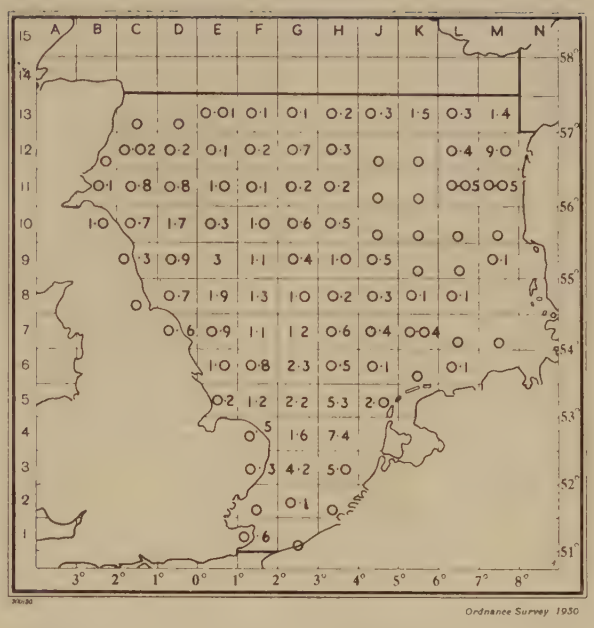


Figure 6. Chart II. Ratio of % distribution of the fishing effort, $\frac{1946}{1938}$.

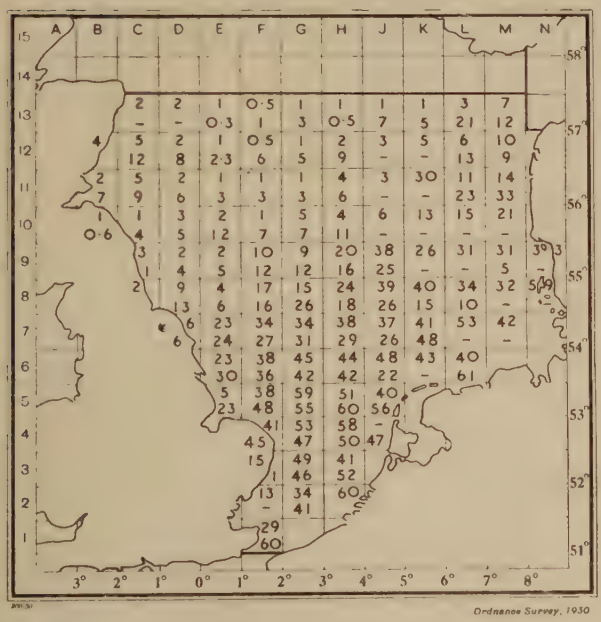


Figure 7. % by weight of Plaice in the demersal landings, 1938 (upper figures) and 1946 (lower figures).

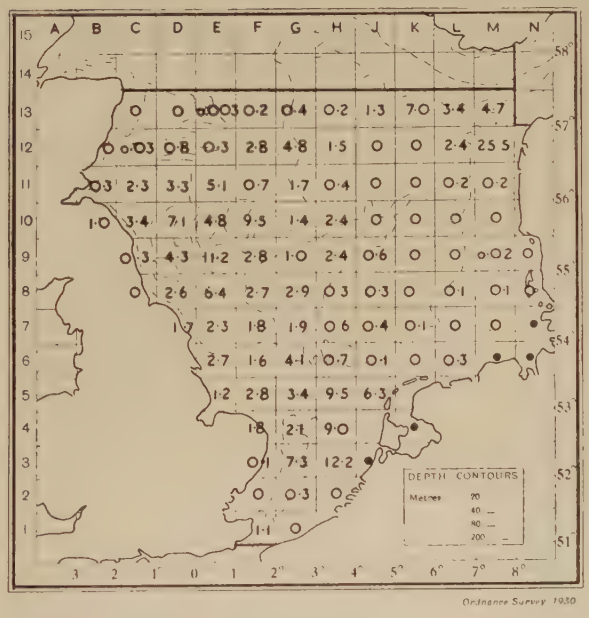
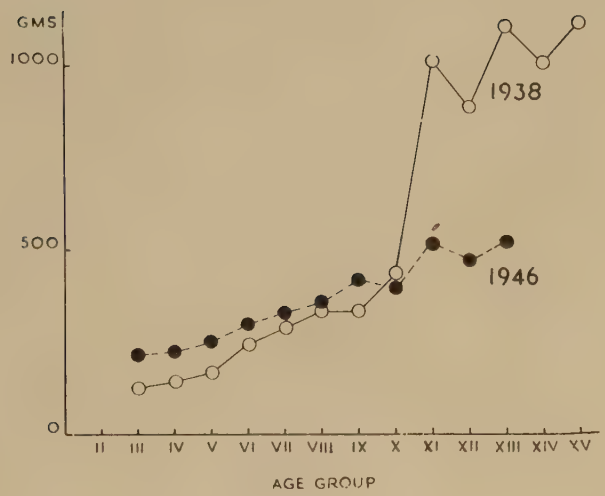
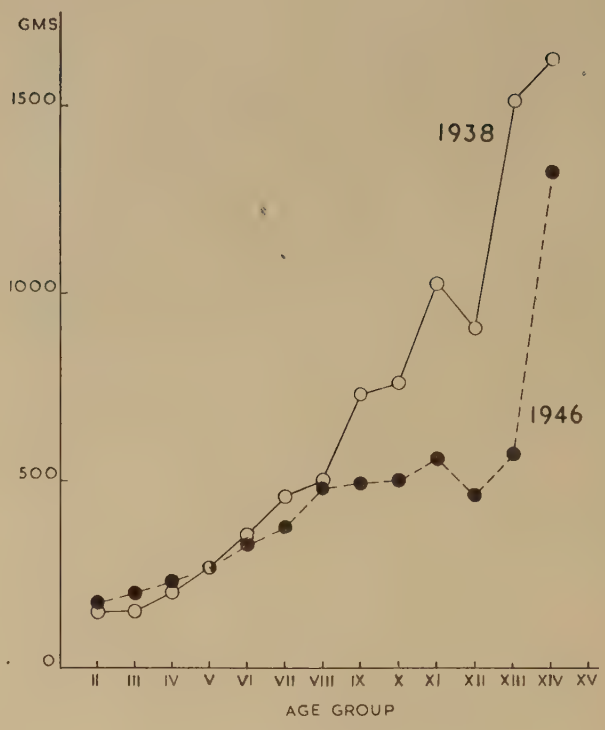


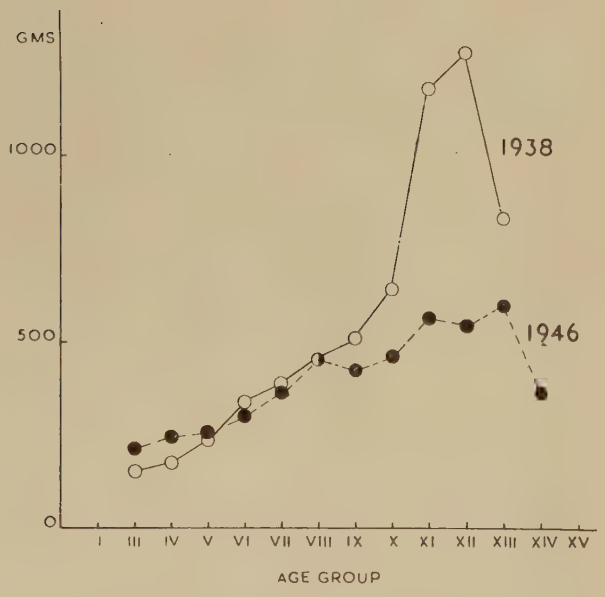
Figure 8. Ratio of Plaice landings from Regions IV b and c, $\frac{1946}{1938}$.



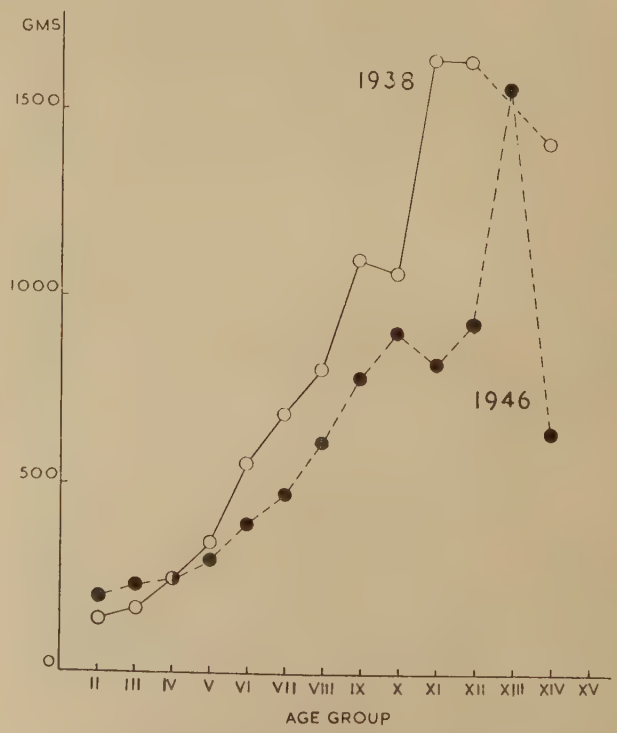
9 a. April (Lowestoft samples).



9 c. October (Lowestoft samples).

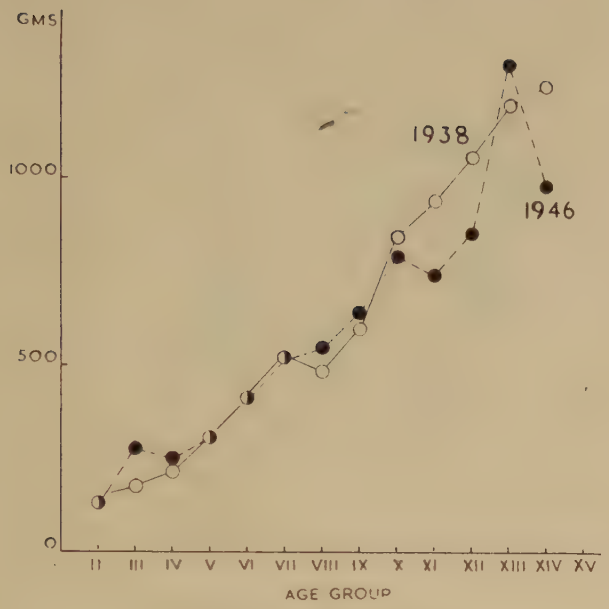


9 b. July (Lowestoft samples).

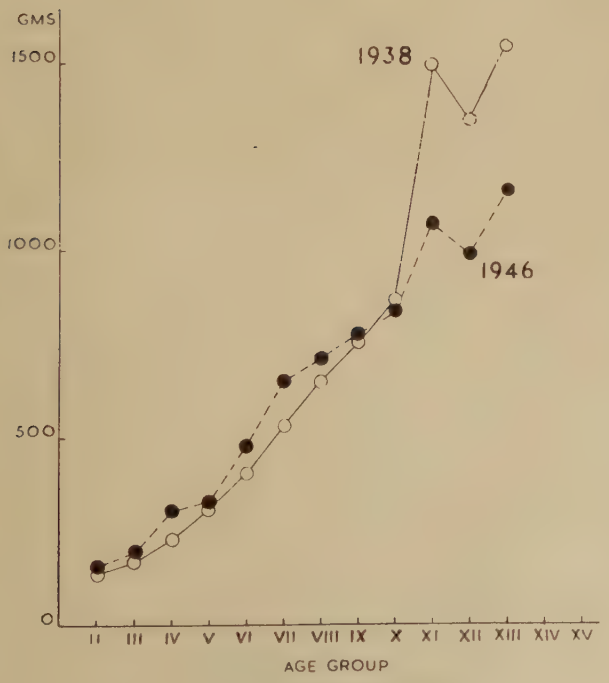


9 d. December (Lowestoft samples).

Figure 9. Mean weights of each age-group from market samples of the North Sea Plaice, 1938 and 1946.



9e. March (Grimsby samples).



9f. December (Grimsby samples).

densities by weight per rectangle of regions IVb and c for each month, calculated in two ways to give "high" and "low" estimates. The "low" values have been computed assuming that there has been no increase in density in the areas which were fished in 1938 but not in 1946, while the "high" values are those computed when it is assumed that the increase in density in these areas has been of average magnitude. It will be seen that both series tend to decrease from January to December, showing that during 1946 the pre-war weight-density of plaice was being approached quite rapidly.

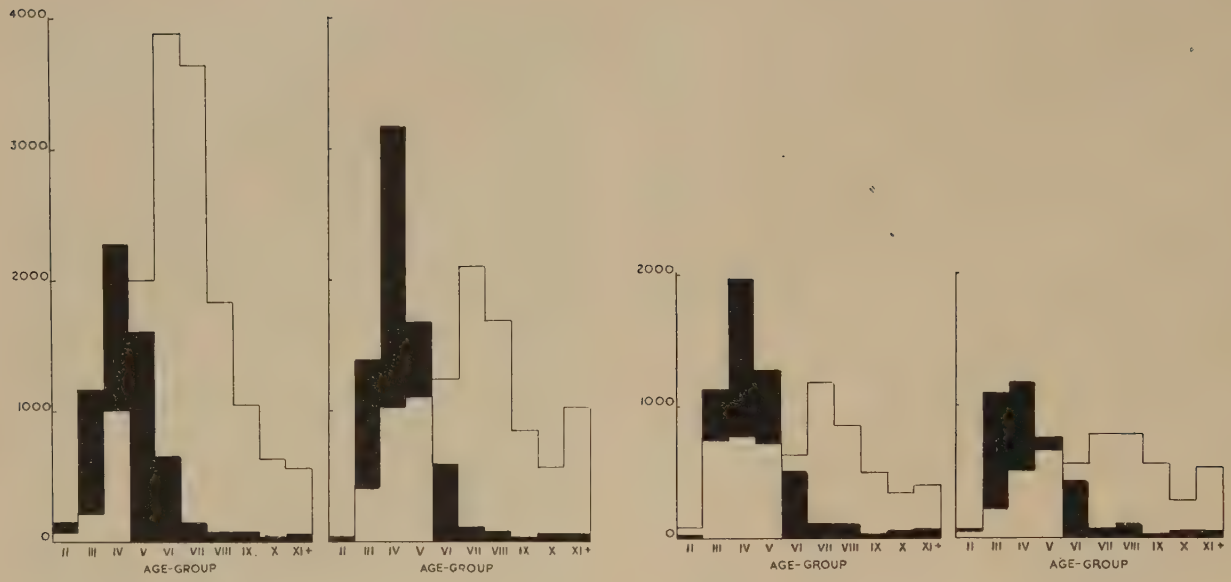
The right hand side of Table 20 has been obtained by multiplying the estimated weight-densities by the corresponding ratio of mean weight of a plaice in 1938 to that in 1946, which remained almost constant at 0·56 with no obvious trend throughout the year. The series for number-density thus obtained behave similarly to the corresponding weight-density series and the decline during 1946 is shown graphically in Figure 14.

Figure 15 shows the estimated monthly changes in number-density in a selected statistical rectangle. During 1946, the logarithmic fishing rate in this area, as determined from an extensive marking experiment, was about 1·5, causing a sharp decline in the abundance of plaice.

The broods which were reaching fishable size at the beginning of the war had a high survival rate because of the great decrease in fishing mortality,

Table 20. Ratios of Post- to Pre-war Plaice Densities in the Southern North Sea (Regions IV b and c), estimated from the Catch per 100 Hours Fishing by 1st-Class Steam Trawlers.

Month	Relative Density $\frac{1946}{1938}$			
	By Weight		By Numbers	
	High estimates	Low estimates	High estimates	Low estimates
Jan.	5·9	2·6	3·8	1·7
Feb.	7·3	3·1	4·7	2·0
March	6·3	2·8	4·1	1·8
April	5·3	3·1	3·4	2·0
May	3·7	2·1	2·4	1·4
June	4·6	2·3	3·0	1·5
July	3·7	2·1	2·4	1·4
August	3·5	2·3	2·3	1·5
Sept.	3·5	2·3	2·3	1·5
Oct.	3·2	2·1	2·1	1·4
Nov.	2·1	1·5	1·4	1·0
Dec.	2·7	1·7	1·8	1·1
Year	3·6	2·8	2·3	1·8
Quarters				
1st	6·5	2·8	4·2	1·8
2nd	4·5	2·5	2·9	1·6
3rd	3·6	2·2	2·3	1·5
4th	2·7	1·8	1·8	1·2



10a. March and April samples. 10b. June and July samples. 10c. September and October samples. 10d. December samples.

Fig. 10. Histograms showing the number of Plaice in each age-group landed in Lowestoft and Grimsby per 100 hours fishing by first-class English steam trawlers in 1938 (black), and 1946 (white).

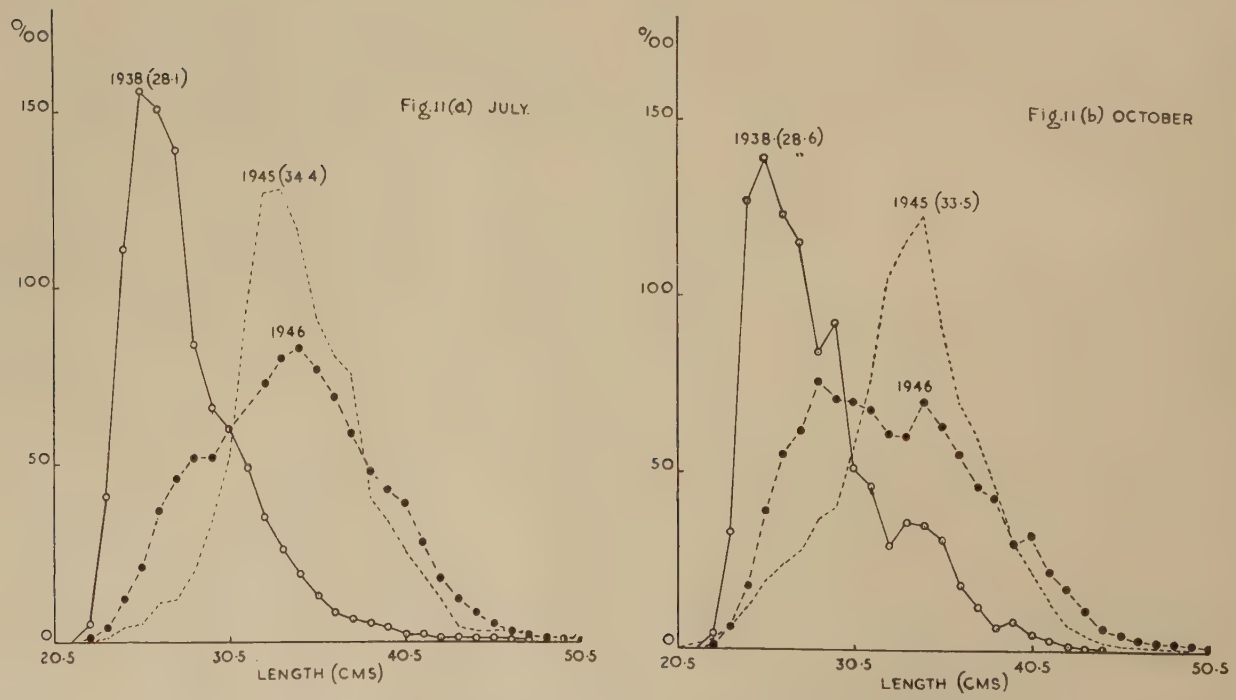


Figure 11. Per mille length distribution of Plaice landed at Lowestoft.

(The mean lengths of the 1938 and 1945 samples are given in brackets.)

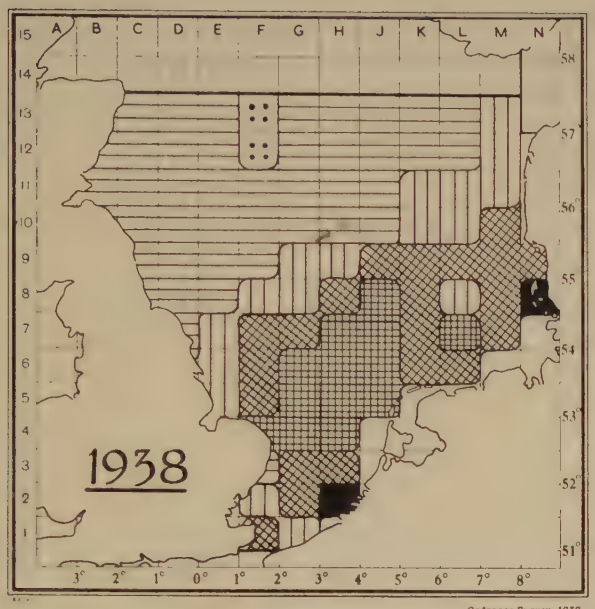


Chart I.

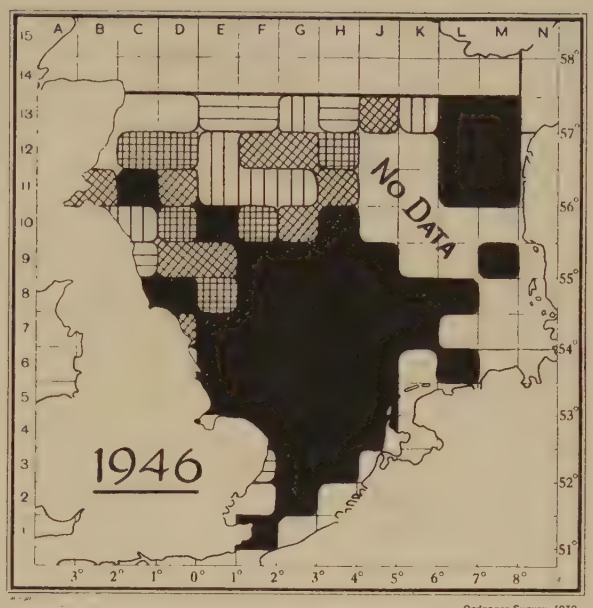


Chart II.

Figure 12, Charts I & II. Landings per 100 hours fishing (cwt.) of Plaice by English steam trawlers from Regions IV b and c.

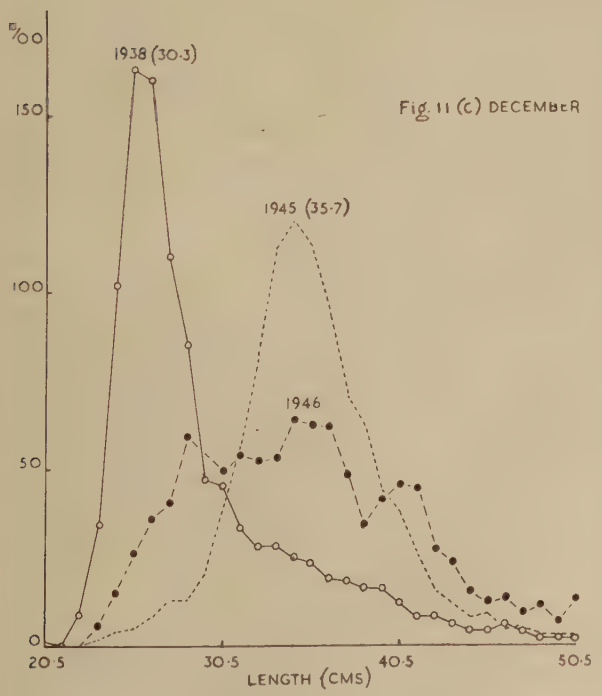


Figure 11 c.

Figure 13. Landings (cwt.) per 100 hours fishing by first-class English steam trawlers in Regions IV b and c, $\frac{1946}{1938}$.

and the greater number-density after the war is due to this, rather than to any increased recruitment of young fish.

This fact also accounts for the very high weight-density ratios in Table 20.

Conclusions of Part II.

1) There have been changes in the density, the length and age distributions, and the growth-rate, of the plaice population of the southern North Sea. The estimated ratio of the density, 1946:1938, is, by weight, greater than 2·8 and probably nearer 3·6, and, by numbers, greater than 1·8 and probably nearer 2·3. (Table 20.)

2) Although during the war there was an increase in the plaice population density in the areas of the southern North Sea fished largely by British vessels, it is being reduced rapidly towards its pre-war level, but it is not, at the time of writing (1947), proven that the population is yet being overfished. (Fig. 13, Table 20.)

3) The increase in the population is mainly one of numbers, due to survival and not to increased recruitment. (Fig. 10.)

4) The changes in the composition of the plaice catch may be accounted for if it is assumed that, although on the whole fishing operations in the southern North Sea were greatly reduced during the war, a considerable thinning of the young plaice stock took place on the coast of the Continent.

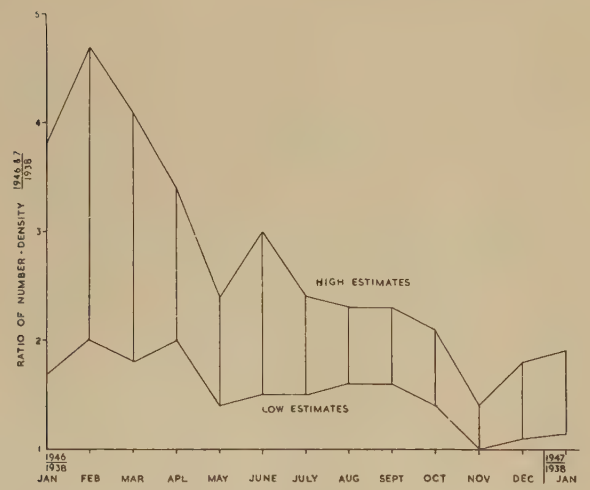

RATIO OF NUMBER-DENSITY 1946 & 7 / 1938
HIGH ESTIMATES
LOW ESTIMATES
1946 / 1938
1947 / 1938
JAN FEB MAR APL MAY JUNE JULY AUG SEPT OCT NOV DEC JAN

Figure 14. The monthly changes in the ratio of post- to pre-war number density of North Sea Plaice (from Table 5).

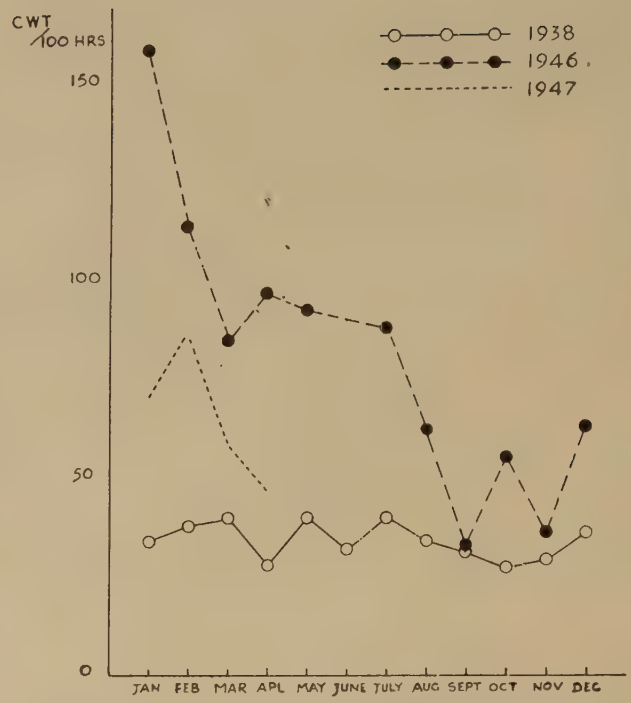


Figure 15. Landings per 100 hours fishing by first-class English steam trawlers from Rectangle G4 in 1938 and 1946.

5) There has been an increase in the relative importance of Lowestoft as a plaice-landing port, and a change both in the seasonal and geographical distribution of the available fishing power, the latter being due, at least in part, to the continued presence of mined areas. (Tables 16 and 19.)

6) The fishing mortality in the central area of region IVc due to British vessels is probably already greater than before the war and exceeding the optimum, but over the whole of the region is only one half of the 1938 figure. (Table 16.)

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2) Davis, F. M., "An account of the Fishing gear of England and Wales." Fish. Invest., Series 2, Vol. XV, No. 2, p. 106 (1936).

3) Hickling, C. F., "The recovery of a deep-sea fishery." Fish. Invest., Series 2, Vol. XVII, No. 1 (1947).

4) Thursby-Pelham, D. E., "The effect of fishing on the stock of Plaice in the North Sea." Rapp. et Proc.-Verb., Vol. CX, pp. 40—63 (1939).

7.

THE HADDOCK STOCKS IN THE NORTH SEA DURING THE SECOND HALF OF 1945

By

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During the years 1940—1945, large areas of the North Sea were closed to trawlers owing to war operations and consequent restrictions, and as a result the fish stocks therein enjoyed a period of greatly reduced exploitation. The main object of this paper is to define the state of the haddock stocks immediately after the cessation of hostilities and before they became reduced in numbers through the resumption of trawling on a large scale.

At this time research vessels were not available to carry out the necessary surveys and so the fish-measuring method was adopted. A team of fish-measurers was employed at sea aboard commercial trawlers, working from Aberdeen, to measure and scale representative samples of the haddock caught on these grounds. The data collected by these workers covered the period July to December 1945, during which time the catches from grounds off the east coast of Scotland were dealt with.

The different areas fished each month cannot be given more accurately than the limits of the statistical squares which are drawn over the North Sea and contiguous waters and referred to by a system of code letters and numbers. The dimensions of each square are $^1/_2{}^\circ$ latitude by 1° longitude, and the area enclosed is approximately 900 square miles. The squares sampled and the number of hours' fishing in each are given in Fig. 1. In most instances each square was trawled over scattered points within its boundaries, so that the population densities recorded for each may be taken as the mean for that area.

The sampling during the period was not fully representative of the total haddock population over the whole of the North Sea at that time, since large areas still remained closed to fishermen, and were not visited. It was, however, representative of the fishing from Aberdeen, as these east coast grounds bore the brunt of the commercial exploitation during the months concerned.

The trawlers aboard which the observations were made were using the V. D. trawl or a modification of it, and at this time the standard cod-end mesh of 24 rows to the yard was in operation. It is known, however, that many vessels were using mesh sizes larger than this standard. Thus some discrepancies between the numbers of small fish caught by different vessels working in the same area in consecutive months were evident, discrepancies which could not definitely be attributed to differences in the abundance of these sizes on the grounds.

Catches by Number and Weight in Each Area.

The total catch in numbers and by weight for each of the areas visited each month has been calculated, and these figures adjusted for the standard fishing time of 100 hours. These figures, together with the total number of hour's fishing in each case, are given in Table 1. The weights are obtained by multiplying the number of fish at each centimetre length by the average weight of gutted fish at that length. These average weights are taken from figures published by Russell[1]). The catch per 100 hours is taken as a measure of the density of the population in each area.

It will be seen that for the period July to December 1945, 611,739 haddock weighing 5,763 cwt. in the gutted condition were caught by the vessels with observers aboard in 2,030 hours. This is equivalent to 30,136 fish and a weight of 283 cwt. for the standard time of 100 hours fishing during the six-monthly period. These figures are based on the catches of vessels which were sampling the grounds

[1]) Russell, E. S. 1914. Market Measurements in relation to the English Haddock Fishery during the years 1909—1911. England and Wales Fishery Investigations, Series II, Vol. I.

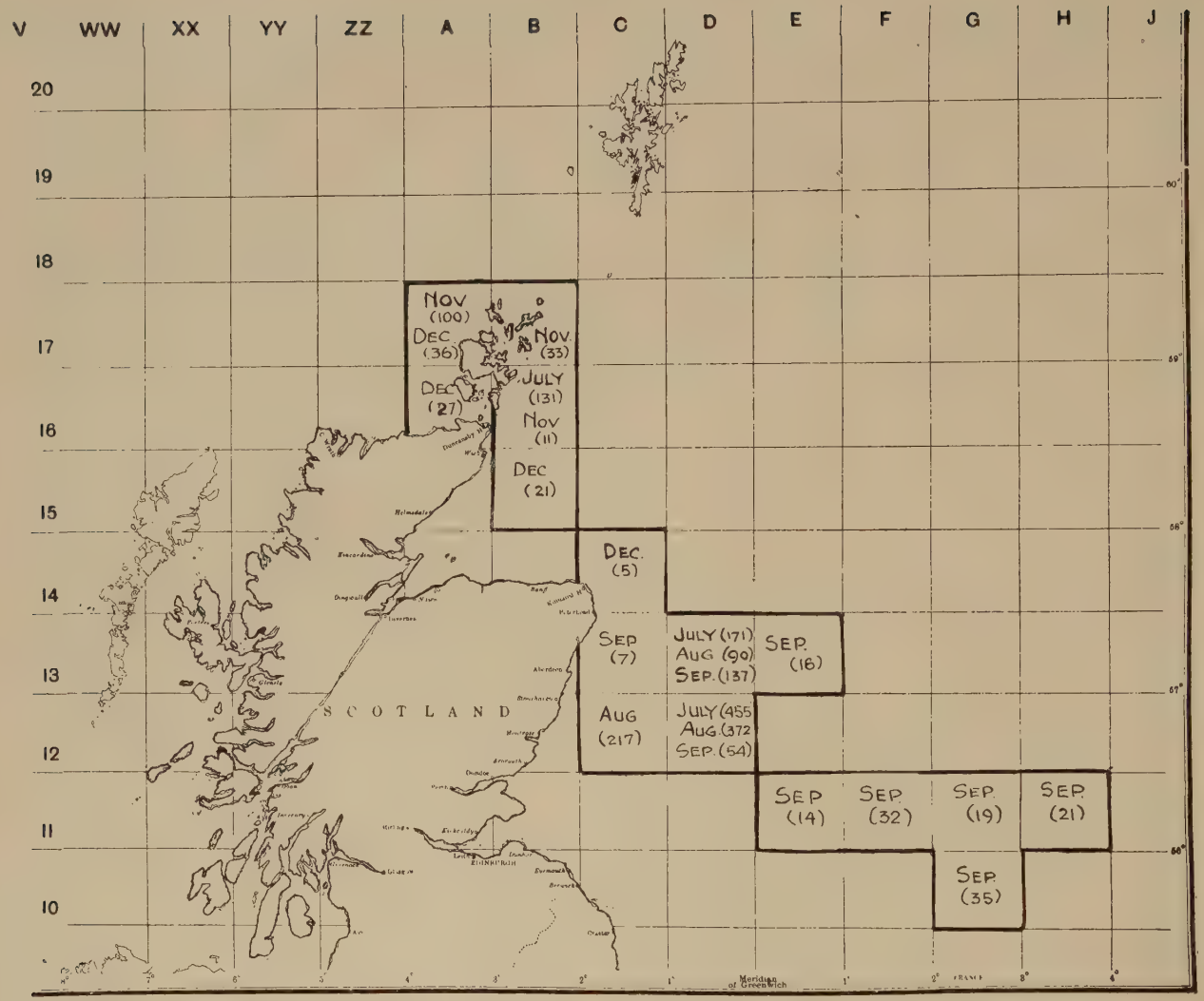


Figure 1. Area visited by Observers and Hours Fishing for each Month during 1945.
(Fishing time in each month given in brackets.)

which constituted the main haddock fishery for Aberdeen trawlers during the period under investigation. They may therefore be regarded as the average yield from this area during the months immediately after the end of the war.

The catches in unit fishing time varied from area to area, both in numbers caught and weight. The number caught ranged from 10,585 in area A 16 in December to 59,454 in area B 16 in July, and in weight from 101 cwt. in A 17 in November to 511 cwt. in G 11 in September. Also, it will be seen that the ratio of number to weight was not constant for all areas. This indicates that the size composition of the stock varied. Two factors may account in large measure for these discrepancies:—

1) Variations in the density of the haddock population from one area to another according to the concentrations of food, local movements and shoaling, and the unequal colonisation of different areas by different age-groups.

2) Variations in the size of mesh used by the trawlers collecting the data, thus retaining unequal numbers of the small fish irrespective of their numbers on the ground.

As a result of this second cause, it is impossible to state definitely to what extent the differences between the numbers and weights caught from one area to another are due to unequal distribution of the fish stocks throughout the area. This factor, however, will only be effective for those sizes which

Table 1. **Total Catch in Number and Estimated Weight.**

Area	Month	Hours Fishing	No. of Fish Caught	Estimated Weight of Fish Caught (cwts.)	No. Caught per 100 Hours	Estimated Weight per 100 Hours
A 16	December	27	2,858	38	10,585	136
A 17	November	100	10,616	101	10,616	101
	December	36	5,029	56	13,970	156
	Total	136	15,645	157	11,504	115
B 15	December	21	11,335	84	53,976	400
B 16	July	131	77,885	424	59,454	324
	November	11	1,428	16	12,982	145
	Total	142	79,313	440	55,854	310
B 17	November	33	7,797	63	23,627	191
C 12	August	217	53,417	584	24,616	269
C 13	September	7	1,969	8	28,128	114
C 14	December	5	1,332	12	26,640	240
D 12	July	455	188,287	1,660	41,382	365
	August	372	102,689	860	860	231
	September	80	16,253	157	157	196
	Total	907	307,229	2,677	33,873	295
D 13	July	171	29,391	321	17,176	188
	August	90	25,249	371	28,045	412
	September	137	50,761	604	37,052	441
	Total	398	105,401	1,296	26,482	326
E 11	September	14	2,806	31	20,043	221
E 13	September	16	2,772	34	17,325	213
F 11	September	32	8,124	143	25,388	446
G 10	September	35	4,012	66	11,463	189
G 11	September	19	5,847	97	30,774	511
H 11	September	21	1,882	33	8,961	157
	Total — All Areas	2,030	611,739	5,763	30,136	283

are able to escape through the meshes of the trawl. Experiments have shown that with the standard cod-end with 24 rows to the yard, 28 centimetres marks the size above which haddock are unable to escape in large numbers. Therefore, for each area, the number and percentage of fish less than 28 centimetres, and the number and percentage 28 centimetres and above have been calculated, together with the corresponding numbers and weights per 100 hours. Also included is the ratio of weight to number of the fish 28 centimetres and above. These figures are set out in Table 2.

The wide differences between the number of haddock less than 28 centimetres in the catches from neighbouring areas, and in the same area in consecutive months, suggest that a variation in the size of mesh used by the different trawlers is a major factor affecting the observed frequencies and yield in unit time from each area. In square D 12, for instance, the number of fish less than 28 centimetres in the August catch was more than twice that in July in the same unit time, and between this area and the adjacent, D 13, the number of these sizes differed by as much as 40 times in August, yet less than twice in September. Earlier investigations have found that young, immature haddock usually remain on the ground, which they colonise when first adopting the bottom habitat, until they make their first spawning migration at the end of their second and third years of life. Haddock less than 28 centimetres are mostly in their first and second years in the North Sea, and, therefore, it is unlikely that movements into or out of the areas would be the cause for the variations in their numbers in the trawl catches.

For the sizes 28 centimetres and above, on the other hand, differences in their numbers in the catches in unit time are more likely to be associated with fluctuations in population density on the grounds. Reference to Table 2 shows that for these sizes area B 15 in December was the most densely stocked, with G 11 yielding the greatest weight. Also, the catches in the same area varied over different months. In D 12 the catch of these sizes between July and

Table 2. Abundance of Fish of Escapable Size in Catches during 1945.

Area	Month	Fish < 28 cm.			Fish 28 cm. and above				
		No. in Catch	% of Total	No. per 100 Hours	No. in Catch	% of Total	No. per 100 Hours	Weight per 100 Hours in Cwt.	Ratio Weight Caught: No. Caught
A 16	December	16	0·6	60	2,842	99·4	10,526	136	0·013
A 17	November	324	3·1	324	10,292	96·9	10,292	101	0·010
	December	66	1·3	244	4,963	98·7	13,786	156	0·011
B 15	December	3,171	28·0	1,400	8,164	72·0	38,876	343	0·009
B 16	July	27,014	34·7	20,600	50,871	65·3	28,833	270	0·009
	November	49	3·4	445	1,379	96·6	12,536	145	0·012
B 17	November	785	10·1	2,379	7,012	89·9	21,248	185	0·009
C 12	August	2,350	4·4	1,083	51,067	95·6	23,533	266	0·011
C 13	September	961	48·8	13,730	1,008	51·2	14,400	71	0·005
C 14	December	351	26·3	7,020	981	73·7	19,260	220	0·011
D 12	July	16,228	8·6	3,567	172,059	91·4	37,813	358	0·010
	August	32,782	31·9	8,812	69,907	68·1	18,792	209	0·011
	September	4,659	29·0	5,821	11,594	71·0	14,493	181	0·012
D 13	July	974	3·3	570	28,417	96·7	16,618	187	0·011
	August	246	0·9	283	25,003	99·1	28,448	412	0·014
	September	4,373	8·6	3,192	46,388	91·4	33,860	432	0·013
E 11	September	191	6·8	1,364	2,615	93·2	18,680	221	0·012
E 13	September	110	4·0	687	2,662	96·0	16,825	213	0·013
F 11	September	90	1·1	281	8,034	98·9	25,106	446	0·018
G 10	September	191	4·7	546	3,821	95·3	10,917	189	0·017
G 11	September	88	1·5	463	5,759	98·5	30,310	511	0·017
H 11	September	60	3·2	286	1,822	96·8	8,676	137	0·016

September was more than halved, whilst in D 13 over the same period it was doubled. Differences of this magnitude suggest that movement of fish from one area to the other took place.

The ratio of weight to number of the larger fish was not constant for all the catches. This suggests that the size composition of the stock was not the same over the region sampled. According to these figures, the most southerly region sampled sustained the largest fish, with the average size decreasing as one travelled northwards. However, the size composition of the stock in the different areas is dealt with in more detail later.

Comparison with Pre-War Yields.

The samples on which the densities of stocks are based for some of the areas visited during 1945 are too small for the results to be regarded as representative of the whole area. In order to compare the catches with those obtained during pre-war years, the areas in which not less than 90 hours' fishing (approximately 30 hauls) were carried out during any one month have been selected. Also, so as to have results for the most southerly area sampled, the figures for squares E 11, F 11, G 10, G 11 and H 11 have been combined. This is considered a justifiable step since the catches by commercial vessels in these areas during pre-war years during the same period fluctuated within narrow limits, suggesting that the haddock population showed little change in numbers and size from one area to another.

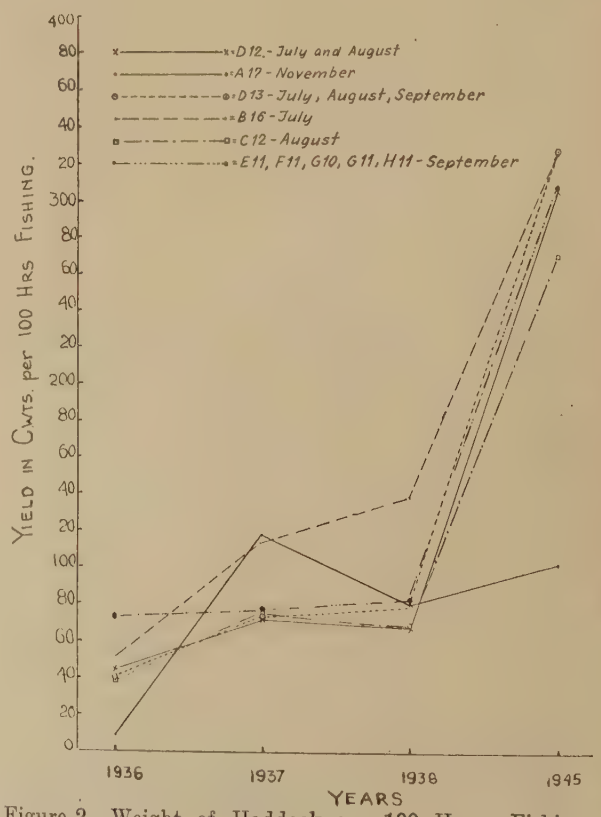

D 12 - July and August
A 17 - November
D 13 - July, August, September
B 16 - July
C 12 - August
E 11, F 11, G 10, G 11, H 11 - September
YIELD IN CWTS. PER 100 HRS FISHING.
YEARS
1936
1937
1938
1945

Figure 2. Weight of Haddock per 100 Hours Fishing. From selected Areas during 1945 and pre-war Years.

Table 3. Total Weights of Fish and Weight per 100 Hours for Selected Areas during 1936–1938 and 1945.

Area	Month	1936		1937		1938		1945	
		Weight of fish caught (cwts.)	Weight per 100 Hours Fishing	Weight of fish caught (cwts.)	Weight per 100 Hours Fishing	Weight of fish caught (cwts.)	Weight per 100 Hours Fishing	Weigth of fish caught (cwts.)	Weight per 100 Hours Fishing
A 17	November.....	7	8	151	117	465	80	101	101
B 16	July.....	2,352	51	2,802	113	7,489	138	424	324
C 12	August	1,475	39	2,925	75	2,029	68	584	269
D 12	July.....	644	38	700	58	503	47	1,660	365
	August	1,536	49	1,455	85	919	89	860	231
	Total...	2,180	45	2,155	74	1,432	67	2,520	304
D 13	July.....	1,933	37	2,279	66	1,225	50	321	188
	August	2,115	37	3,080	95	1,202	70	371	412
	September	1,909	51	1,945	86	3,788	105	604	441
	Total...	5,957	40	7,304	73	6,215	79	1,296	326
E 11, F 11, G 10, G 11, H 11	September	2,659	73	1,540	76	1,853	82	370	306

The areas selected for comparison are tabulated below, along with the month in which they were sampled and the number of hours' fishing for each sample caught during 1945.

A 17	November	100	hours
B 16	July	131	—
C 12	August	217	—
D 12	July	455	—
D 12	August	372	—
D 13	July	171	—
—	August	90	—
—	September	137	—
E 11, F 11, G 10, G 11, H 11	September	121	—

Table 3 gives the total weight of gutted fish, and the weight per 100 hours fishing for the selected areas during 1945 and those for the corresponding areas and months during the years 1936 to 1938. The latter information is taken from the Ministry of Agriculture and Fisheries records for the landings of haddock made at British ports during pre-war years. The results are also plotted in Fig. 2. The 1945 yields refer to a random sample of all the catches from each area.

With the exception of area A 17, where the records fluctuate throughout the period investigated, the weights caught in unit time during 1945 were greatly in excess of those caught in pre-war years. The average increase in yield was approximately five times that obtained in 1938. The greatest difference is observed in area D 12 in July, where the 1945 catches were eight times the weight caught in the same month in 1938.

Size Composition of Stocks.

The results quoted in the preceding section show that the weight of fish caught in unit time on those grounds sampled during 1945 was very much greater than that from the same grounds during the years immediately prior to the war. An increase of this nature could be due to either an increase in the number of fish on the grounds, or a greater average size composition of the stock. An analysis of the samples measured during 1945 has been made in order to determine the size composition of the population.

The measured samples collected during each of the voyages allow the size frequency distribution of each of the catches to be determined. In this way the composition of the stock populating each area during each month may be ascertained. In order to obtain an overall estimate of the size composition for the whole area covered during the period concerned, the distribution in size for all areas and months have been summed, and a combined frequency distribution calculated. This distribution is given in Table 4 and in histogram form in Fig. 3. Here, the number of fish at each length has been adjusted for a total population of 10,000 fish. In addition, the cumulative curve for the distribution is plotted in Fig. 4. It must be pointed out that, since the size of mesh used by commercial trawlers was such that fish less than 28 centimetres were able to escape from the net, the observed frequencies of these sizes in the catches are likely to be unrepresentative of their abundance in the sea.

A study of Table 4 and Figures 3 and 4 reveals the following characteristics of the distribution.

1) Twenty centimetres marks the lower limit of the sizes which were retained in abundance by the commercial trawl and 75 centimetres was the largest recorded specimen.

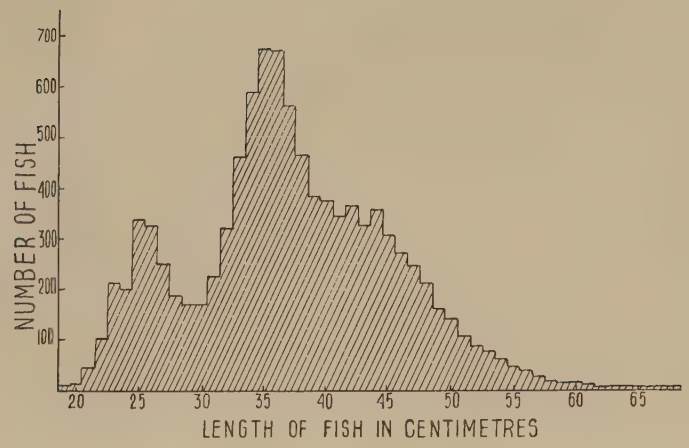


Figure 3. Size Frequencies at each centimetre Length of Haddock caught during 1945 by commercial trawlers on North Sea Fishing Grounds.

Sample Size taken as 10,000 Fish.

2) The distribution was bimodal. The first peak occurred at 26 centimetres and was in the range of sizes which could escape through the mesh. This peak does not therefore define the true frequency of the actual population. The second was at 36 centimetres, and represented the most frequently occurring size. It will be seen later that these peaks mark the centres of the size ranges of the one and two-year-old fish respectively. At sizes greater than 36 centimetres, the number per centimetre decreased rapidly until, in the region of 40 centimetres, a more gradual decline occurred and from this size to the largest recorded individual the decrease was uniform. This portion of the distribution was made up mostly of ages greater than two years.

3) The median of the distribution was at 37 centimetres, which approximates to the peak of the two-year-old fish. The upper and lower quartiles were at 43 and 33 centimetres respectively, which indicates that 50 % of the catchable stock lay within this 10 centimetre range.

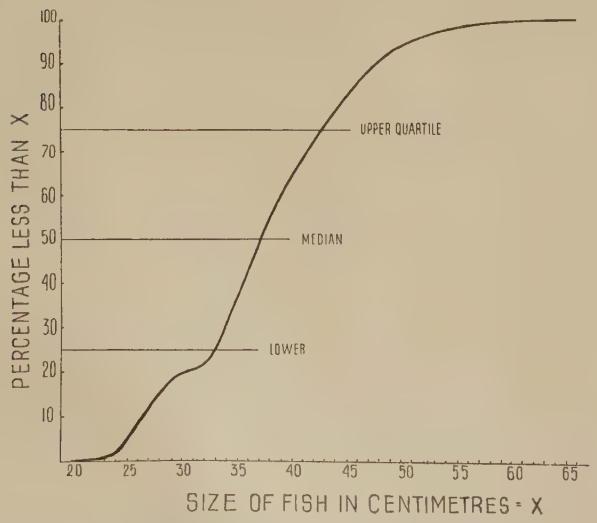


Figure 4. Cumulative Graph of total Haddock sample caught by commercial trawlers during 1945.

Table 4. Size Frequency Distribution of Haddock from All Areas Sampled during 1945.

Length (cm.)	Number of Fish	Cumulative Number	Cumulative Percentage	Length (cm.)	Number of Fish	Cumulative Number	Cumulative Percentage
< 20	269	—	—	48	12,499	552,514	90·3
20	523	269	0·04	49	9,656	565,013	92·3
21	2,428	792	0·1	50	8,566	574,669	93·2
22	5,744	3,220	0·5	51	6,319	583,235	95·3
23	12,659	8,964	1·3	52	4,882	589,554	96·3
24	18,517	21,623	3·5	53	4,558	594,436	97·1
25	20,537	40,140	6·5	54	3,328	598,994	97·9
26	19,138	60,677	9·9	55	2,608	602,322	98·4
27	15,254	79,815	13·0	56	2,065	604,930	98·8
28	11,512	95,069	15·5	57	1,339	606,995	99·2
29	10,267	106,581	17·4	58	899	608,334	99·4
30	10,194	116,848	19·1	59	651	609,233	99·6
31	13,919	127,042	20·7	60	581	609,884	99·7
32	19,609	140,961	23·0	61	391	610,465	99·8
33	28,380	160,570	26·2	62	144	610,856	99·8
34	36,322	188,950	30·9	63	241	611,000	99·8
35	41,433	225,272	36·1	64	139	611,241	99·9
36	41,365	266,705	43·6	65	109	611,380	99·9
37	34,511	308,070	50·3	66	63	611,489	99·9
38	28,329	342,581	56·0	67	90	611,552	99·9
39	23,101	370,910	60·6	68	43	611,642	100
40	22,951	394,011	64·4	69	28	611,685	100
41	21,247	416,962	68·1	70	4	611,713	100
42	22,348	438,209	71·6	71	13	611,717	100
43	20,151	460,557	75·3	72	4	611,730	100
44	21,663	480,708	78·6	73	4	611,734	100
45	18,704	502,371	82·1	74	—	611,738	100
46	16,577	521,075	85·2	75	1	611,738	100
47	14,862	537,652	87·9	76	—	611,739	100

Total = 611,739

Variation in Size Composition between Different Areas.

The distribution described above has been determined by combining the catches from different areas at different months in the year. It has already been stated that the size composition of the catches from each area each month was not constant, and that the most southerly areas yielded the greatest weight per unit number of fish caught. In order to show which sizes predominated in these regions, the size compositions from selected areas have been treated separately.

For those areas in which the catches were based on not less than 90 hours fishing, the size ranges, medians, upper and lower quartiles, and inter-quartile ranges have been determined separately. These are tabulated below.

Table 5. Size Compositions of Catches from Selected Areas.

Area	Month	Size Range (cm.)	Median (nearest cm.)	Upper Quartile (nearest cm.)	Lower Quartile (nearest cm.)	Inter-Quartile Range (cm.)
A 17	November...	10—68	38	41	34	7
B 16	July.....	8—63	31	37	27	10
C 12	August	21—64	38	43	35	8
D 12	July.....	19—67	37	42	34	8
—	August	18—67	35	41	27	14
D 13	July.....	19—61	40	46	35	11
—	August.....	24—67	43	48	38	10
—	September ..	22—63	40	45	36	9
E 11, F 11, G 10, G 11, H 11	September ..	15—75	44	50	39	11

The above figures show that there was a difference of 13 centimetres between the medians of the samples from area B 16 and areas E 11 to H 11; these two samples representing the smallest and largest size compositions respectively. The parameters for the other areas were intermediate between these limits. It has been pointed out earlier, however, that great differences in the numbers of fish of a size which can escape through the meshes of the cod-end, were present in the catches from different areas, and that these differences may not have been due to changes in the abundance of these sizes from one area to another. Such differences will affect the values obtained for the parameters included in Table 5 and may therefore lead to erroneous deductions regarding the size compositions from each. It will be noticed that the medians of the samples from areas D 12 and D 13 differed on the average by as much as five centimetres, which suggests a larger size composition for the latter area. Reference to Table 2, however, shows that it was over the smaller sizes that the greatest differences between the catches from these areas was found. So as to make real differences in the size compositions of the stocks populating each area more evident, the distributions have been recalculated, excluding all fish below 28 centimetres. The frequency at each size above this limit has been calculated for a standard population of 10,000 fish.

As a result of this analysis, three size compositions may be distinguished amongst the areas sampled. The first was characteristic of the area off the east coast of Scotland and to the west of the Orkneys (Squares D 12, D 13, C 12, A 17) and was marked by a maximum size frequency at 36 centimetres, with a secondary peak at approximately 44 centimetres. The combined samples from square D 12 in July and August are plotted in Fig. 5 (solid line). The second type, as found in squares B 16 and B 17 to the east

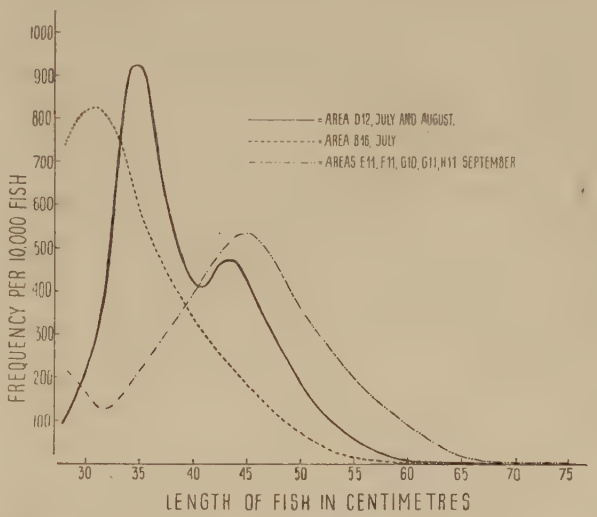


Figure 5. Size Frequency Distribution of Haddock based on sample of 10,000 Fish excluding Fish below 28 cm.

of the Orkneys, had a peak frequency at 30 centimetres, with no secondary peak at the large size. This area contained a higher frequency of smaller fish and relatively few of the sizes which predominated on the other areas (vide Fig. 5, broken line). It must be pointed out, however, that part of this area was open to trawlers during the war years, and therefore some measure of fishing out of the larger fish would have occurred by the time these records were obtained. The third type of size frequency was found in areas E 11 to H 11, and revealed a larger average size than any of the others considered. The mode of this distribution was at 45 centimetres, and relatively few of the sizes predominating in the more northerly areas were present. This distribution is plotted in Fig. 5, dots and dashes.

Age Composition.

The age composition of the catches from all the areas sampled during 1945 cannot be determined since scale samples were not taken from all of them. They were taken, however, from areas A 17 in November,

D 12 in July and F 11 in September, so that the age-groups present in the catches from the northern central and southern regions sampled may be determined. Table 6 (a), (b), (c) summarise the relevant data from each of these areas.

The ages represented in the three samples ranged from 0+ to 10+ years, but of these the 0+, 8+, 9+ and 10+ age-groups made up only 1 % of the total catch. Also, it is seen that the relative abundance of each age-group in the samples was different. In area D 12, one half of the fish were of the 1943 brood, whereas in A 17 and F 11 this age-group constituted approximately one quarter of the total catch. It has been shown that the size composition of the catches from squares D 12, D 13 and C 12 had approximately the same general form; therefore it is likely that the age composition of the stock from this central area was uniform throughout. Also, the fairly uniform conditions of depth and temperature in the areas E 11 to H 11 make it probable that the haddock population in this region was of constant age composition. The ages found in the catch from area A 17 cannot, however, be regarded as characteristic of the Orkney area. This is evident from the differences in the size compositions of the east and west Orkney catches. The B 16 and B 17 catches contained a preponderance of the smaller fish, and were probably composed of a greater preponderance of the 1944 and 1943 broods. This is in keeping with previous years when this area was found to be a young fish area.

Despite the differences in the relative numbers of each age-group present in the catches from each of the three areas concerned, they are alike in that the 1943, 1942 and 1938 year broods figure largely in them. This is especially true of the catches from areas D 12 and F 11. The 1938 brood, although present in smaller numbers than the two younger broods, had at the time of sampling reached a large size and therefore contributed significantly to the total weight of fish caught by trawlers during that period. Also, having in mind that the 1943 brood contained sizes which could escape through the trawl meshes, the two brood years 1943 and 1942 were probably above average for the survival of young haddock.

From the foregoing it is seen that the haddock fishery during 1945, in that part of the North Sea exploited by trawlers from Aberdeen, was dependant almost entirely on fish ranging in age from one to seven years. Of these, two and three-year-old fish made up approximately half of the total number caught. In the years immediately preceding the war, the intensity of fishing was such that a single haddock brood was usually fished out by the time it reached its fifth year of life, and by this age ceased to contribute significantly to the commercial landings. In fact, the haddock fishery in the North Sea was based almost entirely on fish in their second and third years of life. The data collected during 1945, on the other hand, show that approximately

Table 6. Age Composition of Haddock Stocks (Northern Area).

(a) Area A 17 — November.

Year Brood	Age (Years)	Number of Fish Caught	% of Total	Size Range (cm.)	Mean Size (cm.)	Standard Deviation in Size (cm.)
1945	0+	26	0·24	10—17	13·5	2·0
1944	1+	862	8·12	19—33	28·4	2·5
1943	2+	3,059	28·81	29—39	33·7	3·3
1942	3+	3,025	28·49	32—49	38·0	2·9
1941	4+	1,477	13·91	33—49	39·4	3·0
1940	5+	1,236	11·64	33—50	40·6	2·7
1939	6+	289	2·72	36—51	41·8	3·0
1938	7+	637	6·00	39—68	49·3	6·2
1937	8+	5	0·07	61—68	64·4	—
	Total:	10,616	100·0			

(b) (Central Area): Area D 12 — July.

Year Brood	Age (Years)	Number of Fish Caught	% of Total	Size Range (cm.)	Mean Size (cm.)	Standard Deviation in Size (cm.)
1944	1+	18,474	9·81	19—29	24·9	2·3
1943	2+	97,400	51·73	24—45	34·7	2·5
1942	3+	29,970	15·91	35—47	40·7	3·3
1941	4+	8,214	4·36	36—49	42·8	2·1
1940	5+	10,447	5·54	38—52	45·2	4·0
1939	6+	4,279	2·27	40—63	47·1	3·0
1938	7+	19,310	10·25	38—67	48·5	3·4
1937	8+	118	0·06	46—67	51·8	4·3
1936	9+	39	0·04	54—67	56·5	3·5
1935	10+	36	0·03	53—67	56·4	4·0
	Total:	188,287	100·0			

(c) (Southern Area): Area F 11 — September.

Year Brood	Age (Years)	Number of Fish Caught	% of Total	Size Range (cm.)	Mean Size (cm.)	Standard Deviation in Size (cm.)
1944	1+	533	6·56	22—33	29·2	2·9
1943	2+	1,685	20·74	31—46	38·4	3·6
1942	3+	1,958	24·10	37—50	43·5	2·3
1941	4+	1,088	13·39	40—52	46·5	3·2
1940	5+	936	11·52	43—57	49·5	2·7
1939	6+	635	7·82	44—60	51·4	4·3
1938	7+	1,247	15·35	48—69	56·1	5·4
1937	8+	42	0·52	55—69	59·4	3·9
	Total:	8,124	100·0			

a quarter of the sample for which age determinations were possible consisted of ages greater than four years, with seven-year-old fish contributing approximately one-tenth of the total number caught. Since the weight of the seven-year-old fish is approximately six times that of the average for one and two-year-old broods, the contribution to total yield by this age-group was approximately the same as for these young, but more abundant, broods. It was the survival of these older broods, with the consequent greater average weight per fish caught, which resulted in the immediate post-war stocks yielding greater weights per unit of fishing time.

8.

EFFETS DE LA GUERRE SUR LA CONSTITUTION DES STOCKS DE POISSONS

Par

R. Letaconnoux

Le présent travail consiste en l'élaboration de statistiques permettant de comparer la situation de la pêche avant et après guerre, conformément à la décision prise en 1946 par le Conseil International pour l'Exploration de la Mer.

L'unité de comparaison choisie est la pêche d'un chalutier hauturier du port de La Rochelle au cours d'une sortie de douze jours environ. Les statistiques ainsi obtenues portent sur la moyenne des années 1937—1939 d'une part et sur l'année 1946 d'autre part. En plus de la moyenne annuelle nous avons également établi la moyenne mensuelle des apports ce qui permet de mieux comparer le rendement de la pêche des espèces saisonnières.

Nous avons également tenu compte du pourcentage que chaque catégorie de poissons représente dans la pêche générale, ce pourcentage pouvant avoir varié dans un tout autre sens que le tonnage rapporté.

Tableau 1. Apports moyens par sortie avant et après guerre.

Mois	1937—39		1946	
	kg.	n.	kg.	n.
Janv.	14,176	45	26,537	17
Fév.	17,750	43	39,953	9
Mars	13,733	47	41,292	11
Avril	14,430	56	47,444	8
Mai	18,007	63	40,180	10
Juin	19,727	59	39,155	9
Juillet	15,111	58	43,005	11
Août	10,326	48	41,567	9
Sept.	10,516	27	37,102	9
Oct.	10,514	31	31,342	9
Nov.	10,952	35	22,863	7
Déc.	16,124	40	27,287	8
Moy.	14,789		36,135	
Total		552		117

(n. = nombre de sorties.)

Apports Totaux par Sortie.

En 1946 les apports de pêche furent excellents et de 2.4 fois supérieurs à la moyenne des années d'avant guerre avec 36,135 kg. par sortie contre 14,789. Le meilleur mois fut celui d'Avril avec 47,444 kg. mais de Février à Septembre les apports restèrent

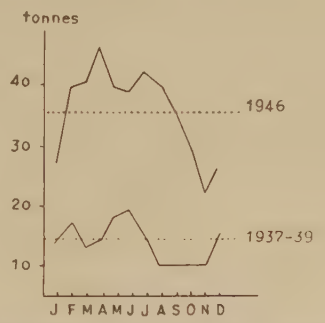


Figure 1. Fluctuations mensuelles des apports d'un chalutier, par sortie, avant et après guerre. En pointillé la moyenne annuelle.

toujours au dessus de la moyenne générale de l'année. Ce n'est qu'au cours des mois de Janvier, Octobre, Novembre et Décembre que les apports furent mauvais, bien qu'étant encore nettement au dessus de la moyenne correspondante des mois d'avant guerre.

Ce qui est remarquable pour l'année 1946 c'est que le maximum de la pêche ait eu lieu en Avril alors que d'ordinaire il a lieu très nettement en Juin après une coupure en Mars. Quant à la baisse du rendement de la pêche en fin de saison elle est normale.

Composition des Apports.

La majorité des apports des chalutiers rochelais se compose de merlu dont le pourcentage était en 1946 à peu près le même que celui d'avant guerre, puis

viennent la dorade, la cardine, la baudroie et le rouget barbet. Avant guerre la baudroie venait au troisième rang, en 1946 elle n'occupait plus que le quatrième.

Pour ces principaux poissons la comparaison est facile à établir mais il n'en est pas de même pour les espèces secondaires dont un certain nombre sont rassemblées dans des catégories communes selon leur valeur commerciale.

Quoi qu'il en soit ce sont surtout les cinq premières espèces qui retiendront notre attention puisqu'à elles seules elles représentent déjà 80 % de la pêche.

Tableau 2. Comparaison des apports, avant et après guerre, en poids et pourcentage par rapport à l'ensemble de la pêche.

	1937—39		1946	
	kg.	%	kg.	%
Merlu	9,652	65·26	23,381	64·60
Dorade	976	6·61	3,343	9·24
Cardine	286	1·90	1,094	3·30
Baudroie	907	6·13	788	2·19
Rouget Barbet	155	1·05	324	0·90
Tacaud	105	0·73	67	0·19
Morue	3	0·02	334	0·92
Eglefin-Lieux	33	0·22	269	0·74
Maquereau	8	0·05	84	0.23
Turbot	38	0·25	12	0·03
Mérou	26	0·17	2	0·01
Grondin, St. Pierre	165	1·11	582	1·61
Congres	314	2·12	578	1·60
Julienne, Squales	350	2·36	471	1·30
Raies	171	1·15	1,161	3·21
Pocheteaux	34	0·23	413	1·14
Encornet	27	0·18	131	0·36
Divers	1,539	10·46	3,155	8·43
Total...	14,789	100·00	36,189	100·00

Merlu *(Merlucius merluccius)*.

En 1946 la pêche moyenne en merlu a été 2·4 fois supérieure à celle d'avant guerre se tenant toute l'année à une moyenne élevée. Le meilleur mois fut celui de Février avec plus de 35 tonnes par sortie contre 13·4 tonnes avant guerre. Par contre Juin n'a pas été comme avant guerre un mois maximum mais il y a eu une baisse lente du rendement de la pêche de Février à Septembre. Puis cette baisse s'est accélérée pendant le dernier trimestre qui a été marqué par de mauvais apports tombant en Novembre au dessous de la moyenne d'avant guerre.

Le pourcentage de merlu capturé a été très voisin du pourcentage moyen de la période 1937—39: 64·6 contre 65·26 %. Si l'on suit les variations mois par mois de ce pourcentage on constate qu'il présente les mêmes variations mensuelles qu'avant guerre, les meilleurs apports en pourcentage ayant eu lieu en Février avec 88·1 % en 1946 contre 76 % en 1937 39. Les autres maxima se placent en Juin et Septembre.

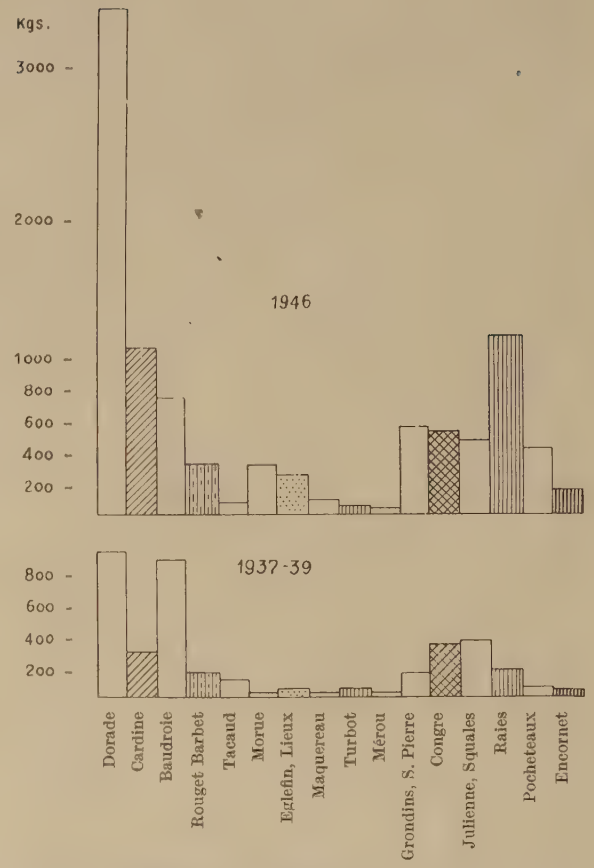
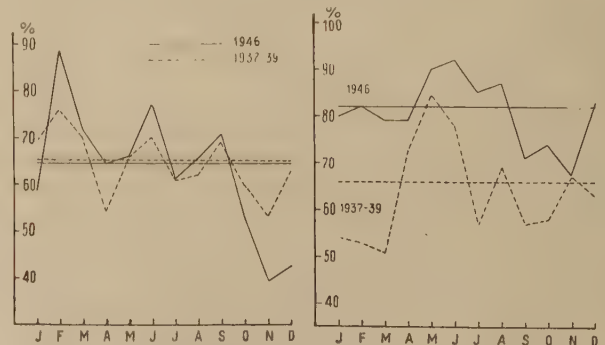


Figure 2. Comparaison des apports entre 1937—39 et 1946 (Merlu et Divers non indiqués).

Les fluctuations de la pêche furent donc les mêmes en 1946 qu'au cours de la période 1937—39 mais les apports furent beaucoup plus considérables en 1946 et particulièrement en Février.

Parmi les apports de merlu on distingue actuellement deux catégories commerciales: merlu et merluchon, la séparation s'effectuant autour de 880 gr.



Figures 3 et 4. Variations mensuelles en pourcentage de la moyenne des apports en Merlu et Merluchon, avant et après guerre.

Tableau 3. Apports en Merlu par mois et moyenne annuelle avant et après guerre.

Mois	1937—39 kg.	1946 kg.
Janv.	9,767	15,569
Fév.	13,491	35,204
Mars	9,631	29,683
Avril	7,881	30,671
Mai	11,847	26,350
Juin	13,890	27,702
Juillet	9,279	25,801
Août	6,454	27,421
Sept.	7,293	26,339
Oct.	6,363	16,643
Nov.	5,867	8,878
Déc.	10,025	11,723
Moy.	9,652	23,381

contre 800 gr. avant guerre. Cette différence de 80 gr. est peu importante et ne doit avoir pour effet que d'augmenter légèrement le chiffre actuel des apports en catégorie merluchon. Or l'on constate que les apports de 1946 se composèrent de 82 % de merlu et 18 % de merluchon contre 66 % de merlu et 34 % de merluchon en 1937—39. Ces chiffres représentent pour 1946, 19,180 kg. de merlu et 4,201 kg. de merluchon et pour la période d'avant guerre, 6,405 de merlu et 3,247 kg. de merluchon.

Il y a donc eu une augmentation générale des captures de merlu et merluchon mais cette augmentation a été considérablement plus importante pour les merlus de bonne taille marchande dont les apports

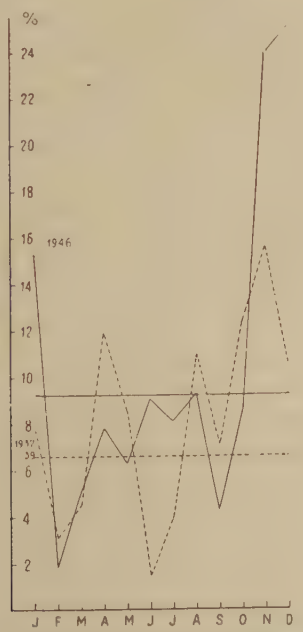


Figure 5. Variations mensuelles en pourcentage des apports en Dorade par sortie, avant et après guerre.

Tableau 4. Apports en Merlu par mois, avant et après guerre.

Mois	Merlu		Merluchon	
	1937—39 kg.	1946 kg.	1937—39 kg.	1946 kg.
Janv.	5,594	12,491	4,173	3,078
Fév.	7,282	28,638	6,209	6,566
Mars	4,927	23,510	4,704	6,173
Avril	5,823	24,253	2,058	6,418
Mai	10,120	23,596	1,727	2,754
Juin	10,709	25,589	3,181	2,113
Juillet	5,369	21,903	3,910	3,898
Août	4,474	23,856	1,980	3,565
Sept.	4,179	18,805	3,114	7,534
Oct.	3,751	12,258	2,612	4,385
Nov.	3,852	6,071	2,015	2,807
Déc.	6,349	9,678	3,676	2,045
Moy.	6,405	19,180	3,247	4,201

de 1946 dépassent de plus de 10 tonnes la moyenne des captures d'avant guerre.

En fait les mensurations effectuées au début de 1946 montrent que le stock de merlu était très riche en individus de 45 à 75 cm. et que le nombre de ceux pouvant atteindre ou dépasser 1 m. était encore appréciable.

Dorade *(Pagellus centrodontus).*

En 1946 le rendement de la pêche à la dorade fut excellent et les chalutiers rapportèrent en moyenne 3,343 kg. par sortie contre 976 avant guerre. Les fluctuations des apports par mois furent sensiblement les mêmes que pendant la période 1937—39 sauf en Juin ou les apports restèrent élevés.

Dans l'ensemble la situation de la pêche à la dorade est donc nettement meilleure qu'avant guerre et l'augmentation du tonnage est encore plus sensible que dans le cas du merlu. En 1946 les apports de dorade furent en effet de 3·4 fois supérieurs à ceux d'avant guerre alors que le merlu n'a progressé que de 2·4 fois.

Tableau 5. Apports en Dorade par sortie avant et après guerre.

Mois	1937—39 kg.	1946 kg.
Janv.	1,111	4,065
Fév.	552	736
Mars	616	2,092
Avril	1,732	3,727
Mai	686	2,523
Juin	283	3,575
Juillet	619	3,486
Août	1,125	3,876
Sept.	750	1,611
Oct.	1,321	2,684
Nov.	1,726	5,472
Déc.	1,696	6,869
Moy.	976	3,343

En ce qui concerne la taille de ces dorades les individus capturés en 1946 et au début de 1947 mesuraient de 23 à 43 cm. mais se groupaient principalement entre 26 et 39 cm. Il s'agissait donc de dorades adultes et de bonne taille marchande.

Cardine *(Zeugopterus megastoma)*.

Les apports de cardine furent 3·8 fois plus élevés en 1946 qu'au cours des dernières années d'avant guerre (1,094 kg. contre 286). Cette amélioration du rendement de la pêche est donc encore plus marquée

Tableau 6. Apports en Cardine par sortie avant et après guerre.

Mois	1937—39 kg.	1946 kg.
Janv.	137	597
Fév.	232	1,040
Mars	291	3,072
Avril	390	1,366
Mai	232	819
Juin	202	931
Juillet	304	1,486
Août	428	1,057
Sept.	437	1,013
Oct.	356	1,263
Nov.	329	986
Déc.	176	328
Moy.	286	1,094

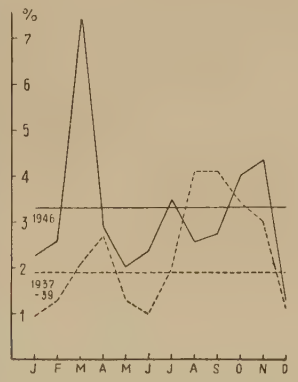


Figure 6. Pourcentage des apports en Cardine.

ici que pour le merlu ou la dorade. Les meilleures pêches eurent lieu en Mars avec plus de 3,000 kg. par marée puis en Juillet avec 1,486 kg. et en Octobre avec 1,263 kg. Comme avant guerre les meilleures pêches se firent donc au début du printemps puis en fin d'été mais en restant toujours à une moyenne bien supérieure aux pêches d'avant guerre.

La taille des cardines capturées en 1946 allait de 15 à 53 cm., la majorité se trouvant entre 20 et 42 cm. La première maturité sexuelle ayant lieu entre 15 et 23 cm. la plus grande partie des captures se composait donc d'individus adultes.[1])

Baudroie *(Lophius piscatorius)*.

Les apports de baudroie sont en légère diminution par rapport à la période d'avant guerre: 788 kg. contre 907. Quant au pourcentage par rapport à la pêche totale il marque un recul encore plus net passant de 6·13 à 2·19 %.

[1]) cf. Furnestin, La Cardine. Rev. Tr. Office. Pêches. t. VIII, f. 2. 1935.

Tableau 7. Apports en Baudroie par sortie avant et après guerre.

Mois	1937—39 kg.	1946 kg.
Janv.	925	870
Fév.	857	299
Mars	608	1,025
Avril	1,060	720
Mai	1,357	979
Juin	1,032	1,087
Juillet	827	888
Août	540	587
Sept.	527	586
Oct.	724	713
Nov.	853	517
Déc.	1,182	972
Moy.	907	788

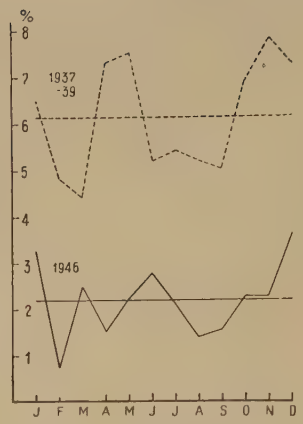


Figure 7. Pourcentage des apports en Baudroie.

Rouget Barbet *(Mullus barbatus)*.

En 1946 les chalutiers débarquèrent un tonnage de rouget barbet égal au double de celui des années d'avant guerre. Le maximum des apports eut lieu en Janvier avec plus de 1,100 kg. par marée contre 325 kg. en Avril au cours des années 1937—39.

Tableau 8. Apports en Rouget Barbet par sortie avant et après guerre.

Mois	1937—39 kg.	1946 kg.
Janv.	116	1,121
Fév.	171	437
Mars	188	169
Avril	325	18
Mai	338	390
Juin	297	364
Juillet	84	6
Août	0	0
Sept.	0	0
Oct.	0	0
Nov.	0	0
Déc.	58	716
Moy.	155	324

Tacaud *(Gadus luscus)*.

Le tacaud n'entre que pour un faible pourcentage dans les apports et, au cours de l'année, les captures sont peu nombreuses. Elles n'augmentent de façon notable qu'au cours de l'hiver atteignant leur maximum en Décembre ou Janvier: 259 kg. en Décembre 1946 contre 215 kg. en Janvier lors des années d'avant guerre. La moyenne des apports en 1946 est cependant inférieure à celle des années d'avant guerre avec 67 kg. contre 105.

Tableau 9. Apports en Tacaud par sortie avant et après guerre.

Mois	1937—39 kg.	1946 kg.
Janv.	215	145
Fév.	221	9
Mars	47	1
Avril	104	15
Mai	105	45
Juin	79	36
Juillet	81	59
Août	30	33
Sept.	5	109
Oct.	27	34
Nov.	151	18
Déc.	184	259
Moy.	105	67

Morue *(Gadus callarias)*.

Au cours de l'année 1946 les chalutiers rapportèrent parfois des quantités assez appréciables de morue, en tous cas bien plus importantes que celles rapportés avant guerre: 334 kg. en moyenne contre 3 kg. soit 0·92 % des apports de 1946. Les captures se firent principalement entre Juin et Octobre atteignant leur maximum en Juillet (2,099 kg. par sortie soit 5·08 % des apports).

Tableau 10. Apports en Morue par sortie avant et après guerre.

Mois	1937—39 kg.	1946 kg.
Janv.	0	0
Fév.	0	0
Mars	0	2
Avril	0	46
Mai	0·5	13
Juin	0·4	133
Juillet	6·7	2,099
Août	18	534
Sept.	14	650
Oct.	0	364
Nov.	0	209
Déc.	0	30
Moy.	3	334

Eglefin — Lieux *(Gadus aeglefinus, G. virens, G. pollachius)*.

En 1946 les apports de lieux et d'églefin représentaient 0·74 % du tonnage total débarqué (269 kg.) et se composaient de:

Lieu Jaune	133 kg.	0·37 %.
Lieu Noir	36 kg.	0·10 %.
Eglefin	100 kg.	0·27 %.

La séparation de ces espèces ne se faisant pas avant guerre, nous ne pouvons que comparer l'ensemble des apports qui se montre en très nette augmentation: 269 kg. au lieu de 33 en 1937—39 soit 8·1 fois plus. Parallèlement le pourcentage est passé de 0·22 à 0·74 %. Les captures maxima se firent en Avril (468 kg. par sortie) et Septembre (1,230 kg.), c'est-à-dire un mois plus tard que les maxima correspondants d'avant guerre, et en Janvier.

Tableau 11. Apports par sortie avant et après guerre.

Mois	1937—39 kg.	1946 kg.
Janv.	17	183
Fév.	20	54
Mars	73	83
Avril	68	468
Mai	29	119
Juin	25	62
Juillet	25	295
Août	26	468
Sept.	12	1,230
Oct.	2	233
Nov.	44	119
Déc.	43	122
Moy.	33	269

Tableau 12. Apports moyens par sortie en 1946.

	Eglefin	L. noir	L. jaune
Janv.	0·7	0·3	182
Fév.	0	1·2	53
Mars	43	3	36
Avril	255	51	37
Mai	45	4·5	69
Juin	27	29	5
Juillet	17	114	163
Août	57	20	390
Sept.	796	118	316
Oct.	45	70	117
Nov.	22	54	43
Déc.	0·7	0·7	121
Moy.	100	36	132
%	0·27	0·10	0·37

C'est surtout de Juillet à Octobre 1946 que ces trois gadidés furent rapportés avec le plus d'abondance, Juillet présentant un maximum des apports de lieu noir, Août de lieu jaune et Septembre d'églefin et lieu noir. Chaque espèce présente d'ailleurs un maximum secondaire, Janvier pour le lieu jaune et Avril pour le lieu noir et l'églefin.

Maquereau *(Scomber scombrus)*.

Le maquereau n'entre que pour un très faible pourcentage dans les apports des chalutiers de La Rochelle n'étant capturé qu'occasionnellement au moment des concentrations sur le fond. Les statistiques à ce sujet ne peuvent donc donner aucune idée

Tableau 13. Apports en Maquereau par sortie avant et après guerre.

Mois	1937—39 kg.	1946 kg.	Mois	1937—39 kg.	1946 kg.
Janv.	0	0	Juillet	0	0
Fév.	29	0	Août	0	2
Mars	53	761	Sept.	0	32
Avril	11	1	Oct.	0	28
Mai	1	68	Nov.	0	0
Juin	0	0	Déc.	0	25
			Moy.	8	84

précise. Nous noterons seulement qu'en 1946 le maximum des captures a eu lieu en Mars comme pendant la période d'avant guerre mais qu'il fut beaucoup plus élevé atteignant 761 kg. au lieu de 53.

Turbot *(Rhombus maximus)*.

Tableau 14. Apports en Turbot par sortie avant et après guerre.

Mois	1937–39 kg.	1946 kg.	Mois	1937–39 kg.	1946 kg.
Janv.	0	0·7	Juillet	51	6·1
Fév.	0	0·7	Août	13	7·4
Mars	0	1·8	Sept.	1·8	11·2
Avril	11	2·1	Oct.	0	2·4
Mai	136	24·3	Nov.	0	5·3
Juin	141	65·4	Déc.	0	0·5
			Moy.	38	12

Alors que les captures de turbot s'élevaient à 38 kg. avant guerre il n'en a été déclaré que 12 kg. par sortie en 1946. Le maximum des captures a lieu en Juin.

Mérou *(Polyprion cernium)*.

Tableau 15. Apports en Mérou par sortie avant et après guerre.

Mois	1937–39 kg.	1946 kg.	Mois	1937–39 kg.	1946 kg.
Janv.	13	2·8	Juillet	14	0·2
Fév.	99	1·6	Août	42	0
Mars	36	4·7	Sept.	54	0
Avril	32	0·5	Oct.	40	0
Mai	3	0·3	Nov.	5	6·1
Juin	1	0	Déc.	7	0
			Moy.	26	2

En 1946, comme dans le cas du turbot, il n'a été déclaré que très peu de mérou. Celui ci n'entre d'ailleurs que pour un très faible pourcentage dans les apports (0·17 %).

Grondins Rouges—Saint Pierre—Rascasses *(Trigla lucerna, T. lyra, T. cuculus; Zeus faber; Sebastes dactyloptera)*.

Grondins rouges, Saint Pierre et rascasse étaient groupés avant guerre dans une même catégorie représentant une moyenne de 165 kg. par sortie soit 1·11 % de la pêche totale. Actuellement les apports sont de 582 kg. soit 1·61 %. Il y a donc eu une augmentation sensible de ces apports qui en 1946 se composaient comme suit:

Grondins rouges	468 kg.	1·30 %
Saint Pierre	95 kg.	0·26 %
Rascasse	19 kg.	0·05 %

Tableau 16. Apports en Grondins Rouges, St. Pierre et Rascasse par sortie avant et après guerre.

Mois	1937–39 kg.	1946 kg.	Mois	1937–39 kg.	1946 kg.
Janv.	65	203	Juillet	125	221
Fév.	96	225	Août	182	454
Mars	137	884	Sept.	232	727
Avril	152	1,310	Oct.	160	998
Mai	296	1,073	Nov.	46	293
Juin	348	544	Déc.	32	340
			Moy.	165	582

Au cours de l'année les apports passent par deux maxima bien nets qui en 1946 furent Avril et Octobre; c'est au moment du premier maximum que les apports sont les plus élevés mais c'est au cours du second qu'ils atteignent le plus fort pourcentage par rapport à la pêche générale.

Tableau 17. Apports par sortie en 1946.

Mois	Grondins rouges	St. Pierre	Rascasse
Janv.	186	5	12
Fév.	273	1	33
Mars	775	34	75
Avril	1,191	103	15
Mai	971	99	4
Juin	460	48	35
Juillet	157	59	4
Août	406	44	3
Sept.	392	333	1
Oct.	630	365	2
Nov.	218	64	11
Déc.	230	88	21
Moy.	468	95	19
%	1·30	0·26	0·05

En 1946, au début de l'année, les apports de rascasses atteignirent leur maximum avec 75 kg. en Mars (un second maximum eut lieu en Juin avec 35 kg.). En Avril eut lieu le maximum des apports de grondins (1,191 kg.) et un premier maximum des apports de Saint Pierre (103 kg.). En Octobre a lieu le maximum secondaire des apports de grondins

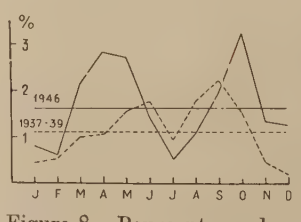


Figure 8. Pourcentage des apports en Grondins.

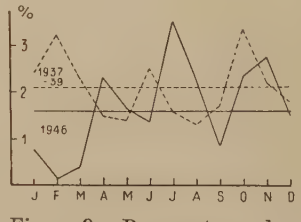


Figure 9. Pourcentage des apports en Congre.

(630 kg.) et le maximum principal des apports de Saint Pierre (365 kg.). En Juillet il y a une coupure très nette des apports et dont il faut vraisemblablement rechercher l'origine dans le déplacement des lieux de pêche les plus fréquentés selon la saison. (Une semblable coupure apparaît dans les apports de mérou au moment même ou a lieu par contre le maximum des captures de turbot.)

Congre *(Conger conger)*.

Tableau 18. Apports en Congre par sortie avant et après guerre.

Mois	1937–39 kg.	1946 kg.	Mois	1937–39 kg.	1946 kg.
Janv.	339	190	Juillet	239	1,478
Fév.	578	69	Août	239	969
Mars	314	167	Sept.	176	304
Avril	217	1,089	Oct.	349	740
Mai	252	652	Nov.	237	615
Juin	487	517	Déc.	286	404
			Moy.	314	578

En 1946 la moyenne des captures de congre (578 kg.) fut 1·8 fois plus élevée qu'au cours des années d'avant guerre (314 kg.). Cette amélioration du tonnage ne se traduit pourtant pas par une augmentation correspondante du pourcentage par rapport à la pêche totale mais par une baisse de 0·52 %.

Julienne et Squales divers *(Molva molva . . .)*.

Là encore les apports de julienne étaient réunis avant guerre avec ceux d'ange (*Rhina squatina*) et de squales divers. La moyenne obtenue en 1946 est de 471 kg. contre 350 kg. avant guerre mais le pourcentage dans les apports a baissé de 2·36 à 1·30. En 1946 les meilleurs apports eurent lieu en Juillet avec 1,524 kg. puis en Octobre avec 884 kg. La composition moyenne des apports fut pour l'année sur 471 kg.:

Julienne	366 kg.	1·01 %
Squales	101 kg.	0·28 %
Ange	4 kg.	0·01 %

Tableau 19. Apports en Julienne et Squales par sortie avant et après guerre.

Mois	1937–39 kg.	1946 kg.	Mois	1937–38 kg.	1946 kg.
Janv.	175	81	Juillet	287	1,524
Fév.	331	71	Août	361	831
Mars	485	200	Sept.	426	505
Avril	449	344	Oct.	419	884
Mai	396	275	Nov.	245	477
Juin	437	496	Déc.	138	106
			Moy.	350	471

Tableau 20. Apports de Julienne, Ange et Squales divers en 1946.

Mois	Julienne	Ange	Squales
Janv.	37	0	44
Fév.	31	4	36
Mars	150	4	46
Avril	254	9	81
Mai	138	13	124
Juin	400	1	95
Juillet	1,458	1	65
Août	818	1	12
Sept.	246	0	259
Oct.	508	9	367
Nov.	390	0	87
Déc.	36	14	56
Moy.	366	4	101
%	1·01	0·01	0·28

Raies (*Raia* sp.).

La comparaison entre les apports de raies, avant et après guerre, est assez difficile à établir étant donné qu'un certain nombre de raies entrait avant guerre dans la catégorie "Divers" qui équivalait à 10 % de la pêche. Nous constaterons seulement qu'au cours de l'année 1946 le maximum des apports a eu lieu en Avril c'est à dire sensiblement à la même époque qu'au cours des années 1937—39.

Tableau 21. Apports en Raies par sortie avant et après guerre.

Mois	1937–39 kg.	1946 kg.	Mois	1937–39 kg.	1246 kg.
Janv.	56	902	Juillet	93	1,140
Fév.	17	240	Août	38	1,038
Mars	66	945	Sept.	6	1,129
Avril	149	2,479	Oct.	10	1,405
Mai	432	1,891	Nov.	104	897
Juin	601	869	Déc.	146	1,298
			Moy.	171	1,161

Pocheteaux *(Raia batis, R. macrorhyncha)*.

Comme dans le cas des raies un certain nombre de pocheteaux figurait avant guerre dans la catégorie

Tableau 22. Apports en Pocheteaux par sortie avant et après guerre.

Mois	1937–39 kg.	1946 kg.	Mois	1937–39 kg.	1946 kg.
Janv.	19	77	Juillet	21	1,010
Fév.	34	27	Août	22	589
Mars	21	437	Sept.	16	313
Avril	32	785	Oct.	26	565
Mai	51	451	Nov.	53	462
Juin	62	301	Déc.	39	112
			Moy.	34	413

"Divers". En 1946 les captures les plus fréquentes eurent lieu en Avril, Juillet et Octobre. La moyenne générale est de 413 kg. par sortie, soit un pourcentage de 1·14.

Encornet (surtout *Ommatostrephes sagittatus* et *Loligo* sp.).

En 1946 les apports d'encornet furent de plus de 4 fois supérieurs à ceux d'avant guerre et le pourcentage dans les apports est passé de 0·18 à 0·36. Les captures les plus abondantes se firent en Décembre comme au cours de la période d'avant guerre, atteignant 965 kg. par sortie.

Tableau 23. Apports en Encornet et Calmar par sortie avant et après guerre.

Mois	1937–39 kg.	1946 kg.	Mois	1937–39 kg.	1946 kg.
Janv.	28	87	Juillet	0	18
Fév.	5	52	Août	0	5
Mars	4	4	Sept.	0	46
Avril	5	51	Oct.	32	180
Mai	5	23	Nov.	80	382
Juin	8	1	Déc.	210	965
			Moy.	27	131

Divers.

Le reste des apports des chalutiers représentait:

en 1937—39	1539 kg.	soit 10·46 %.
en 1946	3155 kg.	soit 8·43 %.

En 1946 ces 3·155 kg. comprenaient:

	kg.	%
Sole	41	0·11
Limande Sole	43	0·12
Plie	51	0·14
Merlan	175	0·48
Poutassou	11	0·03
Phycis	104	0·29
Chiens	478	1·32
Roussettes	143	0·39
Grondin gris	292	0·81
Chinchard	1612	4·58
Divers	205	0·16

En résumé il apparaît que le tonnage rapporté par les chalutiers rochelais a considérablement augmenté depuis la reprise de la pêche après guerre. Il est en effet passé de 14,789 kg. en moyenne à 36,189 kg. ce qui représente une augmentation de 21,400 kg. par sortie.

Les stocks de poissons exploités par les chalutiers étaient donc en 1946 particulièrement riches. On peut dire que presque toutes les espèces ont profité du répit occasionné par la guerre ce qui s'est ensuite traduit par un remarquable accroissement des quantités pêchées.

En tout premier lieu le merlu a particulièrement bénéficié de la guerre puisque les captures de 1946 (23,381 kg.) dépassèrent de plus de 13 tonnes la moyenne d'avant guerre. Cette augmentation est surtout marquée chez les merlus de bonne taille marchande qui passent de 66 à 82 % de l'ensemble du merlu débarqué.

Malgré l'augmentation du tonnage le merlu a conservé dans la totalité des apports à peu près le même pourcentage qu'avant guerre. Il n'en est pas de même pour la dorade et la cardine qui montrent, non seulement une augmentation du tonnage, mais également de leur pourcentage. Eglefin, lieux, morue, grondins, Saint Pierre, rascasse, maquereau sont dans le même cas et vraisemblablement aussi les raies et les pocheteaux.

Le rouget barbet et le congre montrent un accroissement de tonnage mais une diminution de leur pourcentage ce qui indiquerait que leur profit a été moindre.

Deux espèces seulement semblent ne pas avoir tiré bénéfice de l'arrêt de la pêche pendant la guerre: la baudroie et le tacaud dont les apports sont en diminution sensible pour des raisons que nous ne cherchons pas à élucider ici.